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VINT HILL FARMS STATION

Further Delineation of VOC Contamination in Overburden at AREE 34 – Work Plan

FINAL DOCUMENT

NOVEMBER 2003

VINT HILL FARMS STATION

FURTHER DELINEATION OF VOC CONTAMINATION IN OVERBURDEN AT AREE 34

FINAL DOCUMENT

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The former U.S. Army Vint Hill Farms Station (VHFS) closed in September, 1997, pursuant to the Base Realignment and Closure (BRAC) program. As of May 22, 2003, all of the former VHFS property had been transferred to either the Vint Hill Economic Development Authority (VHEDA) or Fauquier County. Area Requiring Environmental Evaluation (AREE) 34 at the former VHFS has been identified as a location where chlorinated volatile organic compound (VOC) groundwater contamination is present in the saturated overburden material and underlying bedrock aquifer. A Remedial Investigation (RI) and a Supplemental RI have been conducted at AREE 34. Based on the results of these investigations, it has been determined that further investigation is required to better define the upgradient extent of the groundwater contamination in the overburden material and to refine the conceptual site model (CSM). This FDVCO-WP presents a dynamic work plan for conducting the investigation using the U.S. Environmental Protection Agency (USEPA) Triad Approach.

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LIST OF ACRONYMS AND ABBREVIATIONS

1,1-DCE	1,1-dichloroethene
1,1,2-TCA	1,1,2-trichloroethane
µg/kg	micrograms per kilogram
µg/L	micrograms per liter
µL	microliters
AAFES	Army, Air Force Exchange System
Accutest	Accutest Laboratories, Inc.
amsl	above mean sea level
AREE	Area Requiring Environmental Evaluation
ASTM	American Society for Testing and Materials
bgs	below ground surface
BRAC	Base Realignment and Closure
CCC	continuing calibration check
CCL_4	carbon tetrachloride
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
cis-1,2-DCE	cis-1,2-dichloroethene
CLP	Contract Laboratory Program
COC	chain-of-custody
Columbia	Columbia Technologies
CSM	conceptual site model
decon	decontamination
DO	dissolved oxygen
DOD	Department of Defense
DQI	data quality indicator
DSITMS	Direct Sampling Ion Trap Mass Spectrometer
EC	electrical conductivity
ECD	electron-capture detector
EST	Eastern Standard Time
FDVCO	Further Delineation of VOC Contamination in Overburden at AREE 34
FDVCO-WP	Further Delineation of VOC Contamination in Overburden at AREE 34 – Work Plan
FID	flame-ionization detector
FOL	Field Operation Leader
FST	Field Sampling Team
ft	feet
GAC	granular activated carbon
GC/MS	gas chromatograph/mass spectrometer
GPS	global positioning system
HCl	hydrochloric acid
I.D.	inside diameter
IDW	investigation-derived wastes
LCS	laboratory control sample
MCL	Maximum Contaminant Level
MDL	method detection limit
MIP	Membrane Interface Probe
mL	milliliters
MQL	method quantitation limit
MRD	Missouri River Division
MS/MSD	matrix spike/matrix spike duplicate
NEPA	National Environmental Policy Act
NFG	National Functional Guideline
ng	nanogram

NPL	National Priority List
O.D.	outside diameter
PCE	tetrachloroethene
PDB	passive diffusion bag
PEC	performance evaluation check
PID	photoionization detector
ppb	parts per billion
ppbV	parts per billion vapor
PPE	personal protective equipment
ppm	parts per million
PT	performance test
PVC	polyvinyl chloride
QA	quality assurance
QA/QC	quality assurance/quality control
QC	quality control
RI	Remedial Investigation
RL	reporting limit
RPD	relative percent difference
SARA	Superfund Amendments and Reauthorization Act
SDG	Sample Delivery Group
Shaw	Shaw Environmental, Inc.
SOP	Standard Operating Procedure
SRI	Supplemental Remedial Investigation
TCE	trichloroethene
TCL	Target Compound List
TDI	thermal desorption interface
Tri-Corders	Tri-Corders Environmental, Inc.
USACE	U.S. Army Corps of Engineers
USCS	Unified Soil Classification System
USEPA	U.S. Environmental Protection Agency
VDEQ	Virginia Department of Environmental Quality
VHEDA	Vint Hill Economic Development Authority
VHFS	Vint Hill Farms Station
VOA	volatile organic analysis
VOC	volatile organic compound
WG	Work Group
WSRT	western South Run tributary

1.0 INTRODUCTION

This Further Delineation of Volatile Organic Compound (VOC) Contamination in Overburden at Area Requiring Environmental Evaluation (AREE) 34 – Work Plan (FDVCO-WP) has been prepared to better define the nature and extent of the VOC contamination detected in the saturated overburden material at AREE 34 at the former Vint Hill Farms Station (VHFS) in Warrenton, Virginia.

The former VHFS is located approximately 40 miles southwest of Washington, D.C., in Fauquier County, Virginia, and approximately 11 miles northeast of Warrenton, Virginia. The general location of the former VHFS is shown on Figure 1-1. VHFS, while active, primarily functioned as an Army installation engaged in communications intelligence. VHFS closed in September, 1997, pursuant to the Base Realignment and Closure (BRAC) program. All of the former VHFS property has been transferred to the Vint Hill Economic Development Authority (VHEDA) or to Fauquier County as part of a public benefit conveyance. The former VHFS property was transferred in three pieces, with the final transfer occurring on May 22, 2003.

Although the former VHFS is not a National Priority List (NPL) site, the field work and data evaluation will generally follow U.S. Environmental Protection Agency (USEPA) guidance documents developed for activities performed under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA). In addition, the FDVCO-WP activities will be conducted in compliance with U.S. Army Corps of Engineers (USACE) technical guidance and quality assurance (QA) requirements (USACE, 1994a,b); the National Environmental Policy Act of 1969 (NEPA); and the President's Council on Environmental Quality (CEQ) regulations (40 National Code of Federal Regulations [CFR] 1500-1508). The procedures that will be used in the study are consistent with the Department of the Army's environmental policy toward integrating the NEPA and CERCLA/SARA process.

The FDVCO investigation will utilize the USEPA Triad approach to manage decision uncertainty (i.e., to increase confidence that project decisions about contaminant presence, location, fate, exposure, and risk reduction are made correctly and cost-effectively). A primary product of the Triad approach is an accurate conceptual site model (CSM) that is the foundation for decisions that are both correct and optimized from a cost-benefit standpoint. The Triad approach achieves this by actively identifying and managing decision uncertainties and data uncertainties, and by incorporating advanced science and technology tools. The Triad approach consists of three major elements:

- Systematic project planning;
- Dynamic work strategies; and
- Real-time measurement systems.

Systematic project planning, the most important element of the Triad, ensures high decision confidence by developing: a consensus on the desired outcome for the site; a preliminary CSM from existing data; scientific, engineering, and regulatory decisions required to achieve the desired outcome; a list of the unknowns that impede making those decisions; strategies to eliminate or "manage around" those unknowns; and explicit control over the greatest sources of uncertainty in the environmental data (i.e., sampling-related variables). Dynamic work strategies is the element that allows the project to adapt in real time (i.e., while the work crew is still in the field) to new information as it becomes available. Preliminary CSMs can be tested and sufficiently evolved in the field to the desired level of decision confidence required to complete the project. Real-time measurement systems using advanced science and technology tools, such as field analytical instrumentation, in situ sensing systems, and computerized data management/visualization tools, allow data to be gathered, interpreted, and shared sufficiently fast to support real-time decisions.

This study will be performed under the purview of the U.S. Army and the Virginia Department of Environmental Quality (VDEQ). A Field Sampling Team (FST) that will include a senior hydrogeologist from Shaw Environmental, Inc. (Shaw), a senior person from Columbia Technologies (Columbia) for the Membrane Interface Probe (MIP) operation, a senior person from Tri-Corders Environmental, Inc. (Tri-Corders) for the Direct Sampling Ion Trap Mass Spectrometer (DSITMS) analysis, and field technical support from each of the three firms will conduct the field activities. The senior hydrogeologist from Shaw will act as the Field Operation Leader (FOL). The FST will interact with the Work Group (WG), which will consist of personnel from the USACE Baltimore, Department of Defense (DOD) BRAC Office, VDEQ, USEPA Innovative Technology Office, and USACE Seattle.

1.1 PHYSICAL SETTING OF AREE 34

This section provides information describing the physical setting of AREE 34. The reader is referred to the AREE 34 Remedial Investigation (RI) Report (USACE, 2003a) for information regarding the past, current, and future uses of AREE 34 and the surrounding buildings.

1.1.1 Site Location and Topography

AREE 34 is located due east of Building 2400 in the southern central portion of the former VHFS property (see Figure 1-2). AREE 34 consists of approximately one-third acre based on the results of the AREE 34 RI (USACE, 2003a), and is primarily covered by an asphalt parking lot in a previously industrial area of the former VHFS. This area has been paved since 1966 based on a review of historical building drawings.

The topography in the vicinity of AREE 34 is fairly flat with surface elevations ranging from 406.84 to 411.61 feet (ft) above mean sea level (amsl).

1.1.2 Surface Water Hydrology

The former VHFS property is located in the Occoquan watershed. Most of the property drains to South Run (located along the northwestern boundary of the former VHFS property, see Figure 1-2) via intermittent tributaries and drainage ditches. South Run is a small Class III Virginia stream which discharges into Lake Manassas, a recreation and drinking water reservoir built on Broad Run for the City of Manassas. The most prominent tributary located on the former VHFS property that drains to South Run is western South Run tributary (WSRT) show on Figure 1-2. The headwaters of WSRT are located approximately 900 ft to the north-northwest of AREE 34.

1.1.3 Geology/Hydrogeology

The central portion of VHFS is underlain by folded sedimentary rocks of the Catharpin Creek Member which consists of sandstone, arkosic sandstone, siltstone, shale, and claystone. These units strike north-northeast and dip approximately 40 degrees west-northwest (USATHAMA, 1981). Intrusions of basalt, oriented northeast to southwest, cut the bedrock in the central portion of the former VHFS property close to where AREE 34 resides.

Previous geological investigations performed as part of the AREE 34 Supplemental Remedial Investigation (SRI) (USACE, 2003b) have shown that bedrock is present at approximately 23 to 30 ft below ground surface (bgs), becoming shallower from west to east (see Figure 1-3). Based on previous hydrogeologic studies at the former VHFS, the bedrock encountered in well borings was massive and sporadically fractured (USACE, 1999). The bedrock is overlain by reddish-brown clay and silt overlying a brown, saprolitic, silt and fine sand (a chemical and physical weathering product of the underlying bedrock) which increases in density with depth.

Groundwater at the former VHFS property occurs in fractured bedrock and to a lesser extent in the overburden. Although most portions of the bedrock in the region have low porosity and permeability, particularly the basalt and diabase dikes, groundwater is found in zones of fractured bedrock. These fracture zones trend parallel and perpendicular to the trench axes (northeast-southwest). Because groundwater flow is primarily restricted to fracture zones, permeability and storage capacity in bedrock may be variable and limited. The bedrock aquifer is semi-confined, with the unfractured bedrock and saprolite acting as confining units. Recharge to the fractured bedrock aquifer occurs at outcrop areas and from percolation from the overburden along fractures.

The overburden at AREE 34, which consists primarily of clay and silt overlying saprolite, also contains groundwater. Much like the bedrock, saprolite is relatively dry and impermeable where it is unfractured, so the quantity of groundwater the overburden contains is limited mostly by its thickness and the extent of fracturing. The quantity of groundwater stored in the clay and silt overlying the saprolite is limited by the thickness of the soil. The overburden serves as a reservoir for slow recharge to the bedrock along fractures. The saturated overburden material is unconfined.

Water level surveys conducted at AREE 34 during the SRI (USACE, 2003b) showed that: 1) the water table ranges between 4.9 and 11.8 ft bgs in the contaminated portion of the saturated overburden; 2) the direction of horizontal groundwater flow in the saturated overburden is north-northwest to west-northwest (see Figure 1-4); and 3) the direction of horizontal groundwater flow in the fractured bedrock aquifer varies between east-southeast and due east (see Figure 1-5). The general direction of horizontal groundwater flow in the bedrock aquifer is approximately opposite of the direction of horizontal groundwater flow in the saturated overburden material. The closest drinking water supply source is Production Well No. 1 which is located 400 ft to the south-southeast of AREE 34 (see Figure 1-2). Production Well No. 1 is hydraulically downgradient of AREE 34 with respect to the general direction of groundwater flow in the bedrock aquifer and hydraulically upgradient of AREE 34 with respect to the direction of groundwater flow in the saturated overburden material.

1.2 OVERVIEW OF THE AREE 34 RI AND SRI

For discussion of the identification of AREE 34 and investigation activities that occurred in the vicinity of AREE 34 prior to the AREE 34 RI, the reader is referred to Section 1 of the AREE 34 RI Report (USACE, 2003a).

As part of the AREE 34 RI performed from March to July, 2001 (USACE, 2003a), the following investigation activities were performed:

- 26 temporary monitoring wells were installed;
- Groundwater samples were collected from the temporary monitoring wells as well as pre-existing monitoring well NP-PZ2 and analyzed for Target Compound List (TCL) VOCs (see Figure 1-6);
- Three new permanent saturated overburden monitoring wells (MW34-1, MW34-2, and MW34-3) were installed;
- Groundwater samples were collected from the three new monitoring wells and four pre-existing saturated overburden monitoring wells and analyzed for TCL VOCs (see Figure 1-7); and
- Four soil borings were advanced from which a total of 32 soil samples were collected and analyzed for TCL VOCs.

Based on the temporary monitoring well program and the permanent monitoring well sampling conducted during the RI, the VOC contaminant plume in the saturated overburden at AREE 34 was presumed to impact an area of approximately one-third acre. The impacted area appeared to begin at approximately the center of the existing parking lot and move due west toward the former photo neutralization pit site and Building 2400. Four VOCs were detected above their corresponding Maximum Contaminant Levels (MCLs) established under the Safe Drinking Water Act (USEPA, 1996a) (see Figure 1-7). These four VOCs are: carbon tetrachloride (CCl_4) (maximum detection = 6.6 micrograms per liter [μg/L]; MCL = 5 μg/L); 1,1-dichloroethene (1,1-DCE) (maximum detection = 32 μg/L; MCL = 7 μg/L); tetrachloroethene (PCE) (maximum detection = 29 μg/L; MCL = 5 μg/L); and trichloroethene (TCE) (maximum detection = 37 μg/L; MCL = 5 μg/L). The MCL exceedences are sporadic (see Figure 1-6) indicating no discernible "point" source, but rather the impact of possibly one or more small spills of solvent. This conclusion is supported by the results of subsurface soil sampling which identified nondetectable concentrations of the VOCs (i.e., no ongoing source) except for a trace level of carbon disulfide at 10 – 12 ft bgs below the center of the parking lot.

As part of the AREE 34 SRI performed from October, 2002, through January, 2003 (USACE, 2003b), the following investigation activities were performed:

- One new permanent saturated overburden monitoring well was installed;
- Three new permanent bedrock aquifer monitoring wells were installed; and
- Groundwater samples were collected from the four new monitoring wells and seven pre-existing saturated overburden monitoring wells and analyzed for TCL VOCs (Figures 1-8 and 1-9).

Based on the saturated overburden monitoring well sampling conducted during the AREE 34 SRI (USACE, 2003b), the VOC contaminant plume in the saturated overburden material at AREE 34 is more extensive than initially determined during the AREE 34 RI (see Figure 1-8). The impacted area extends further to the south-southeast to at least the location of saturated overburden monitoring well MW34-4. The highest detected individual VOC concentrations (primarily), as well as total VOC concentrations (736.46 μg/L), detected during the AREE 34 SRI were detected in the groundwater sample from saturated overburden monitoring well MW34-4. Four VOCs were detected above their corresponding MCLs as follows: CCl_4 (maximum detection = 280 μg/L; MCL = 5 μg/L); 1,1-DCE (maximum detection = 171 μg/L; MCL = 7 μg/L); PCE (maximum detection = 64.8 μg/L; MCL = 5 μg/L); and TCE (maximum detection = 126 μg/L; MCL = 5 μg/L). The MCL exceedences remain sporadic indicating no discernible "point" source, but rather the impact of possibly one or more small spills of solvent.

Based on the bedrock aquifer monitoring well sampling conducted during the AREE 34 SRI (USACE, 2003b), the bedrock aquifer is also contaminated with VOCs (see Figure 1-9). Five VOCs were detected above their corresponding MCLs (see Figure 1-9). These five VOCs are: CCl_4 (maximum detection = 9.1 μg/L; MCL = 5 μg/L); 1,1-DCE (maximum detection = 156 μg/L; MCL = 7 μg/L); PCE (maximum detection = 84.4 μg/L; MCL = 5 μg/L); TCE (maximum detection = 81.8 μg/L; MCL = 5 μg/L); and 1,1,2-trichloroethane (1,1,2-TCA) (maximum detection = 6.2 μg/L; MCL = 5 μg/L). Bedrock aquifer monitoring well MW34-7D contained the highest concentration of total VOCs (342.49 μg/L) of the three bedrock aquifer monitoring wells sampled. Bedrock aquifer monitoring well MW34-7D is the most upgradient bedrock aquifer monitoring well based on the general direction of horizontal groundwater flow in the bedrock aquifer at AREE 34. As discussed in Section 1.1.3, Production Well No. 1 is located 400 ft hydraulically downgradient of AREE 34 with respect to the general direction of horizontal groundwater flow in the bedrock aquifer. The VOC contamination in the bedrock aquifer decreases as it moves downgradient toward Production Well No. 1 (total VOCs are 27.9 μg/L at MW34-5D and 2.96 μg/L at MW34-6D). Recent sampling and analysis of groundwater discharging from Production Well No. 1 showed no detectable concentrations of VOCs at a detection limit of 0.5 μg/L, suggesting that there is limited hydraulic connection between the contaminated bedrock aquifer monitoring wells at AREE 34 and Production Well No. 1.

A review of historic building drawings conducted by Shaw in June, 2003, identified two features that should be considered when evaluating the presence of subsurface VOC contamination at AREE 34 (see Figure 1-10). The line of saturated overburden monitoring wells showing high concentrations of TCE and PCE (i.e., NP-PZ2 and MW34-2 in particular) are in line with an abandoned sewerline behind Building 2400. This abandoned sewerline initiated at Building 2410, a building which housed operations that do not appear to have used chlorinated solvents. Further, monitoring well MW34-1, located near the start of the abandoned sewerline, does not contain detectable levels of VOCs. The highest concentrations (primarily) of VOCs, particularly CCl_4, identified at AREE 34 are at the location of saturated overburden monitoring well MW34-4, which is located at the former location of an incinerator.

1.3 OBJECTIVES OF FURTHER DELINEATION OF VOC CONTAMINATION IN OVERBURDEN

Data gaps were identified based on the results of the AREE 34 RI and SRI Reports. Specifically, the SRI data clearly show that the extent of the VOC contamination in the overburden is not defined in the southeasterly direction.

Objectives of this FDVCO are to:

1. Identify the highest concentration of VOCs in the overburden soil and groundwater;
2. Determine the placement of additional permanent saturated overburden monitoring wells, if any, to further evaluate risk posed to human health; and
3. Gather soil analytical data, if warranted, to evaluate risk posed to human health.

1.4 FDVCO-WP ORGANIZATION

This FDVCO-WP consists of the following sections:

Section 1.0 – Introduction
This section presents a brief history of the VOC contamination detected in the groundwater at AREE 34. This section also presents the objectives of the FDVCO and the FDVCO-WP organization.

Section 2.0 – Passive Diffusion Bag Sampling
This section describes the installation of passive diffusion bag (PDB) samplers in selected existing saturated overburden and bedrock aquifer monitoring wells, and the sampling methodology used to collect groundwater samples from PDB samplers.

Section 3.0 – High Density Sampling
This section describes the Geoprobe® drilling technique that will be used to drive a MIP for the collection of nearly continuous, real-time VOC data. This section also describes the procedures for collection of sorbent traps for speciation of VOCs using an on-site DSITMS.

Section 4.0 – Collaborative Soil and Groundwater Sampling
This section describes the considerations to be used in making decisions to collect collaborative soil and groundwater samples, the drilling technique that may be used to collect collaborate soil samples and drill borings for placement of temporary monitoring wells, the methods for collecting collaborative subsurface soil samples, the temporary monitoring well construction and installation details, and the temporary monitoring well sampling procedures.

Section 5.0 – On-site Direct Sampling Ion Trap Mass Spectrometer Analysis
This section describes the operation of the DSITMS for on-site analysis of sorbent trap samples, collaborative soil samples, and PDB and temporary monitoring well groundwater samples for VOCs.

Section 6.0 – Off Site Sample Handling
This section describes the documentation (i.e., sample labels and chain-of-custody [COC] forms) required for environmental samples sent for off-site laboratory analysis as well as the packing and shipping procedures.

Section 7.0 – Off-site Laboratory Analysis
This section describes the analytical methodologies to be used for off-site analysis of PDB groundwater samples and collaborative soil and groundwater samples for TCL VOCs. This section also presents the procedures to be used to review or validate the off-site analytical results.

Section 8.0 – Data Management and Communications
This section describes the data that will be placed into the data management system (historical data as well as FDVCO field data), the frequency of data input, and how that data management system will be made available to the WG on Columbia's secure web-page.

Section 9.0 – Decontamination
This section describes the decontamination procedures for the drill rig and downhole equipment, temporary monitoring well casing and screen, and non-disposable sampling equipment.

Section 10.0 – Disposal of Investigation-Derived Wastes
This section describes the proposed methods for handling and disposing of the decontamination/purge waters and the drill cuttings generated by the FDVCO field activities.

Section 11.0 – FDVCO Proposed Schedule
This section presents the proposed schedule for the FDVCO investigation.

Section 12.0 – References

2.0 PASSIVE DIFFUSION BAG SAMPLING

PDB groundwater samples will be collected for VOC analysis from four saturated overburden monitoring wells and two bedrock aquifer monitoring wells prior to the start-up of the remainder of the FDVCO-WP activities. The PDB samplers will be positioned within each well to provide complete coverage throughout the well screen interval, or the water column, whichever is shorter. The goals of the PDB groundwater sampling are: 1) to determine the vertical stratification, if any, of VOC contamination in the groundwater to provide background data relative to the subsequent high density sampling (see Section 3) program; and 2) to assess, assuming there is stratification of the VOC contamination, whether the source may be local or some distance away. Shaw will install the PDB samplers in the wells, remove the PDB samplers from the wells, and collect the groundwater samples from the PDB samplers. Tri-Corders will conduct the on-site analysis of the PDB groundwater samples for VOCs using the DSITMS (see Section 5). Should the FST decide the send any of the PDB groundwater samples off site for VOC analysis, Shaw will arrange for the off-site laboratory analysis of the samples, and will package and ship the samples to the off-site laboratory (see Section 6).

2.1 PASSIVE DIFFUSION BAG SAMPLING LOCATIONS

PDB samplers will be installed in saturated overburden monitoring wells MW34-2, MW34-3, MW34-4, and NP-PZ2 and in bedrock aquifer monitoring wells MW34-5D and MW34-7D. The PDB groundwater samples from the saturated overburden monitoring wells will provide VOC stratification information within the well screen intervals that will suggest whether a source is in the immediate area of the monitoring wells (i.e., higher concentrations at the very top of the well screen) or from some further distance away (i.e., higher concentrations at the very bottom of the well screen). The stratification of VOC contamination in saturated overburden monitoring well MW34-4 will be used to better understand the results of the high density sampling at its point of initiation (see Section 3). The PDB groundwater samples from the bedrock aquifer monitoring wells will provide results regarding the stratification of VOC contamination within the well screen interval that may be useful for subsequent investigative phases and in refining the CSM.

2.2 PASSIVE DIFFUSION BAG SAMPLING PROCEDURES

The PDB samplers will be 2 ft long and will be installed so that there is continual coverage of the well screen interval or water column in each monitoring well. Prior to placement of the PDB samplers, the depth to water and total depth for each of the six selected monitoring wells will be measured, with an electric water level indicator with an accuracy of 0.01 ft, from the top of the polyvinyl chloride (PVC) casing and recorded in the field logbook. The tape and probe will be decontaminated between measurements at different wells, as discussed in Section 9.5. The total length of the water column will then be calculated and recorded. The number of PDB samplers will be determined based upon the monitoring well screen length (10 ft in all monitoring wells except NP-PZ2 which has a 15 ft well screen) or the water column length. If the water column length is less than the well screen length (i.e., the water table is below the top of the well screen), the water column length shall be used to determine the number of PDB samplers to be deployed. The number of PDB samplers to be installed in each monitoring well will be the screen length or water column length (whichever is shorter) divided by 2, and rounded down to the nearest whole number (e.g., a 15-ft screen interval would utilize seven PDB samplers).

At each well location the following procedure will be performed:

a. Fill each PDB sampler with deionized, organic-free water and remove any air pockets if any are visible;

b. Insert the bottom plug into each PDB sampler (a small air bubble from the plug is of no concern);

c. Connect a stainless steel weight to the bottom of the bottom PDB sampler, making sure the weight is hanging below the plug;

d. Attach the PDB samplers to a tether line such that the bottom of the top sampler is just above the top of the second sampler, etc.;

e. Lower the tether line with the filled PDB samplers into the well; and

f. Secure the tether line so that the stainless steel weight at the bottom is approximately 0.1 ft from the bottom of the well.

The PDB samplers will remain within the well for at least 2 weeks to allow for: 1) the equilibration of the well hydraulics (water levels to return to static levels and the flow through the well screen to return to equilibrium – about one week); and then 2) equilibrium of the VOC concentrations in the groundwater and the PDB samplers (up to 7 days).

After a minimum of two weeks, the PDB samplers will be retrieved from the monitoring wells. A groundwater sample will be collected from each PDB sampler. For each groundwater sample, a total of five 40 milliliter (mL) volatile organic analysis (VOA) vials will be filled with zero headspace. Two of the vials will be unpreserved (hold time of 7 days), and three of the vials will be preserved with hydrochloric acid (HCl) to pH of <2 (hold time of 14 days). All groundwater sample bottles will be kept on ice at the site to maintain a temperature of 4±2°C until the samples are analyzed for VOCs by Tri-Corders using the on-site DSITMS (see Section 5.2.3), shipped off site for TCL VOC analysis by the off-site laboratory (see Section 7), and/or discarded.

All of the PDB groundwater samples will be analyzed for VOCs using the on-site DSITMS. The unpreserved sample aliquots will be used for the on-site VOC analysis as long as the samples are analyzed within the 7-day holding time. If on-site VOC analysis occurs after the 7-day holding time for the unpreserved sample aliquots, then the preserved sample aliquots will be used for this purpose.

In addition, the FST may decide to send one or more of the PDB groundwater samples off site for TCL VOC analysis. The FST's decision will be based predominantly on the results of the on-site DSITMS analysis of the PDB groundwater samples and will consider such information as whether:

- The DSITMS identified a compound not detected in previous groundwater samples; or
- The detected concentrations are an order of magnitude greater than previously detected.

If off-site laboratory analysis is to be conducted, the remaining preserved sample aliquots will be used for this purpose, and off-site analysis will be conducted with an expedited turnaround time due to the limited sample holding time that remains.

When collecting the groundwater samples from the PDB samplers, there will be no pre-sample purging because the PDB samplers will already be in equilibrium with the groundwater flowing through the well screen. Since there will be no pre-sample purging, there will be no monitoring of field stabilization parameters (temperature, pH, conductivity, redox, dissolved oxygen [DO], and turbidity). The following PDB groundwater sampling procedures will be followed:

1. A clean piece of plastic sheeting will be spread on the ground around the well to protect the sampling equipment from possibly becoming contaminated.
2. Headspace readings in the well and in the breathing zone immediately above the well will be taken with a photoionization detector (PID).
3. If VOCs are measured in the well with the PID, the well will be allowed to ventilate for several minutes. If all PID readings are less than 1 part per million (ppm) in the samplers' breathing zone, Level D personal protective equipment (PPE) will be worn while sampling the well. If the PID readings are continuous (exceeding 1 ppm but not greater than 5 ppm) in the samplers' breathing zone, then Level C PPE will be worn while sampling the well. If the PID readings are continuous above 5 ppm in the samplers' breathing zone, the site will be evacuated.
4. The depth to water will be measured, with an electric water level indicator with an accuracy of 0.01 ft, from the top of the PVC casing and recorded in the field logbook. The tape and probe will be decontaminated between measurements at different wells, as discussed in Section 9.5.
5. The groundwater sample will be discharged directly from the PDB sampler into the sample containers (five 40-mL VOA vials) by removing the bottom plug of the PDB sampler or using a disposable discharge tube. If a disposable discharge tube is used, the tube will be pressed into the clear polyethylene membrane of the PDB sampler until it pierces the membrane.

Flow will begin immediately from the discharge tube. Two of the VOA vials will not contain any preservative (7-day holding time), and the other three VOA vials will be preserved to a pH of <2 with HCl (14-day holding time). The VOA vials will be filled slowly to minimize air bubbles and agitation of the sample. The VOA vials will be filled with zero headspace.

6. Sample bottles will be labeled, enclosed in a plastic bag, and placed in a cooler maintained at 4±2°C immediately after sample collection and preservation.
7. The field sample number, number of sample containers, sample container type, and sample preservation method will be recorded for each PDB groundwater sample collected on the Sample Collection Log Sheet (included as part of the Daily QC Report; see Section 6.3).

Disposable sampling equipment will be discarded as discussed in Section 10.2. Any excess sample water remaining in the PDB samplers will be containerized in a 55-gallon drum and disposed with the decon water from the FDVCO investigation as discussed in Section 10.1.

For PDB groundwater samples being sent for off-site analysis, sample bottles will be packaged and shipped as discussed in Section 6.

Each PDB groundwater sample will be given a unique field sample number that will identify the location and screen interval of the sample. An example of the field sample numbering system is:

MW34-4-PDB-1

where:

MW34-4 = Indicates the well identification number from which the groundwater sample was collected;

PDB = Indicates this is a PDB groundwater sample; and

1 = Indicates the relative location of the PDB sampler on the sample tether and in the well screen (i.e., 1 = the top of the well screen, and 5 = the bottom of the well screen [in wells with 10-ft well screens]).

On-site DSITMS analysis of the PDB groundwater samples will begin with the samples from saturated overburden monitoring well MW34-4 and bedrock aquifer monitoring well MW34-5D since these wells are located in the area where the high density sampling will be conducted (see Section 3).

2.3 FIELD QUALITY CONTROL FOR PDB GROUNDWATER SAMPLES

Field duplicate PDB groundwater samples will be collected from the PDB samplers to provide an indication of the variability associated with matrix heterogeneity and to assess sampling precision. Field duplicate PDB groundwater samples will be collected at a frequency of 10% (i.e., one field duplicate for every 10 primary samples) for analysis of VOCs using the on-site DSITMS. Field duplicate PDB groundwater samples will have the same field sample number as the primary sample with a “D” added to the end (e.g., MW34-4-PDB-1D). Since it is uncertain whether any of the PDB groundwater samples will be sent off site for laboratory analysis to collaborate the on-site DSITMS results, duplicate PDB groundwater samples will not be sent to the off-site laboratory for analysis.

Equipment blanks will not be collected since PDB groundwater samples are collected directly from the disposable PDB samplers. Since the PDB samplers are disposable, decontamination is not required. Therefore, cross-contamination between samples as a result of sampling equipment decontamination procedures is not an issue.

Daily field blanks (designated as Fmmddyy) will be prepared by pouring deionized, organic-free water into two unpreserved 40-mL VOA vials. Field blanks will be analyzed for VOCs using the on-site DSITMS to ensure that the deionized, organic-free water used to fill the PDB samplers is free of contamination and to identify contamination from exposure to atmospheric contaminants.

Field QC samples associated with the PDB groundwater samples being shipped off site for laboratory analysis will be limited to trip blanks. Trip blanks are intended to identify contamination from exposure to atmospheric contaminants that may occur during various stages of the sampling process including: shipment of bottles to the site; storage of bottles on site; collection of samples on site; storage of samples on site; shipment of samples to the laboratory; and storage of samples at the laboratory. Trip blanks (designated as Tmmddyy) will accompany PDB groundwater samples to the off-site laboratory and will be analyzed for TCL VOCs by the off-site laboratory. The trip blanks will be prepared by the off-site laboratory, shipped to the site along with the sample bottles, and shipped back to the laboratory with the samples.

Field QC samples will be documented on the Sample Collection Log Sheet (all samples) and/or on the COC form (off-site samples only) (see Section 6).

3.0 HIGH DENSITY SAMPLING USING MEMBRANE INTERFACE PROBE

A high density sampling program, utilizing a MIP with support from the on-site DSITMS, will help achieve the objectives of the FDVCO investigation. The MIP collects up to six channels of data at a time; these channels of data include three chemical data sets, electrical conductivity (EC), penetration rate, and temperature. The MIP will continuously monitor environmental conditions with depth using a PID and an electron-capture detector (ECD). Although the MIP is also equipped with a flame-ionization detector (FID), the FID will be taken off-line so that sorbent trap samples can be collected. A portion of the MIP vapor will be split, and VOCs will be captured on a sorbent trap and analyzed for VOCs using the on-site DSITMS (see Section 5). The EC, penetration rate, and temperature data provided by the MIP will provide insight into the subsurface lithology and presence of saturated zones. These tools will generate real-time data that will be used by the FST to decide where, and how, to continue the FDVCO investigation.

Prior to initiation of the MIP investigation, Shaw will: 1) arrange for clearance of underground utilities through VHEDA personnel and Miss Utility; and 2) layout the sampling grid system described in Section 3.4. Columbia will operate the Geoprobe® drill rig and MIP, collect the sorbent trap samples, and upload real-time data from the field investigation into its data management system for posting on a secure web-page (see Section 8). Tri-Corders will analyze the sorbent trap samples (see Section 5) using the on-site DSITMS.

3.1 MEMBRANE INTERFACE PROBE EQUIPMENT

The MIP is a down-hole probe that consists of a heating block, a gas permeable membrane, and a gas loop to bring the gases that migrate across the membrane to the surface for analysis. The heating block is normally set to attain temperatures of 120°C. The temperature of the probe is quenched when it penetrates groundwater, and if maximum temperature is desired, then the standard operating procedure (SOP) calls for stopping advancement at specific intervals for the probe to reheat. The purpose of the heating block is to volatilize VOCs that the probe comes in contact with. These volatiles then migrate across a Teflon®-coated, stainless steel membrane and are captured in the inert gases that sweep the backside of the membrane and are brought to the surface for analysis. The membrane does get damaged with wear and when encountering sharp gravels or fill material, but is easily replaced. Carrier gas flow rate is monitored to detect when the membrane is damaged.

EC sensors are located near the leading tip of the probe. The measurements recorded by the EC sensors provide an indication of grain size and thus different soil strata. In addition, if contaminant concentrations are high enough, the EC sensors may also provide an indication of ion content and thus contaminant distribution with depth.

A rubber-coated transfer line protects the electrical conduit and gas lines and connects the probe to the surface analytical equipment. This transfer line is threaded through the rods that are used to push the probe into the ground. At the surface, the gases are delivered to the analytical instrumentation of choice. There are a variety of ways to analyze the extracted gases. The most common approach involves running the gases through a series of detectors, typically a PID, a FID, and an ECD, to measure total VOC response. This high productivity protocol is often adequate for locating sources and mapping the extent of the compounds of interest. The PID is often used for aromatic compounds (e.g., benzene, toluene, ethylbenzene, and xylene), the FID is used for alkanes (e.g., methane), and the ECD is used for chlorinated hydrocarbons (e.g., TCE, PCE, CCl_4). The PID, FID, and ECD measure total VOCs and have a sensitivity of approximately 500 parts per billion (ppb).

Since alkanes are of less importance to the AREE 34 investigation than chlorinated and aromatic hydrocarbons, the FID will not be used for this FDVCO investigation. In its place, sorbent traps will be collected for analysis using the on-site DSITMS (see Section 5.2.1) to speciate the VOC compounds. The DSITMS results from the sorbent traps should not be considered a quantitative measurement for comparison with soil or water results, but should be used solely as a means for speciation of the individual VOC components that contribute to total MIP VOC response.

3.2 MEMBRANE INTERFACE PROBE OPERATION

The MIP will be hammered into the ground one foot at a time utilizing a Geoprobe® drill rig. As it is pushed into the cool ground, the probe cools down. At each foot interval, the probe is allowed to heat back up in order to optimize its ability to volatilize chemical constituents that it comes in contact with. Near real-time measurements are recorded and can be observed on a lap top computer available in the associated analytical van.

In addition to the real-time measurements, the gas stream will be trapped onto a Tenax® tube for VOC analysis by the on-site DSITMS (see Section 5.2.1). These samples are referred to as sorbent trap samples. (Note: Tenax® tubes will be reused; therefore, each sorbent trap sample will be run through the DSITMS twice to ensure that the Tenax® tube is clean.) The gas stream over a 5-ft interval will be concentrated into one sorbent trap sample. Based on real-time results from the PDB groundwater samples or from the MIP, the FST may decide to advance a second MIP at a specific location to collect sorbent traps for shorter intervals at specific depths to further evaluate site conditions. Each sorbent trap sample will be given a unique field sample number that will identify the location and depth interval of the sample. An example of the field sample numbering system is:

F20-ST-(5-10)

where:

F20 = Indicates the AREE 34 grid location (as discussed in Section 3.4);

ST = Indicates that this is a sorbent trap sample; and

(5-10) = Indicates the depth interval (ft bgs) over which the gas stream has been concentrated.

If additional MIP probes are advanced at a specific location for any reason, they will be designated with a “(2)”, “(3)”, etc. after the grid location [e.g., F20(2)-ST-(5-10)]. Each sorbent trap sample will be recorded in the field logbook and on the Sample Collection Log Sheet (included as part of the Daily QC Report; see Section 6.3).

The Geoprobe® operator will monitor the advancement of the probe and advise the MIP operator when refusal has been met. At this point, the rods will be removed from the ground, the hole sealed, and the vehicles will move to a new location. The MIP does not require decontamination between sampling locations because contaminants are burned off as a result of the high operating temperatures used during operation of the MIP. Normally 150 to 250 linear feet of production can be obtained per day, depending upon site conditions, the operating mode, and the type of push system utilized.

The MIP will be operated in accordance with the Geoprobe® MIP SOP (see Appendix A). The sorbent traps will be collected following the SOP for collection of sorbent traps provided in Appendix B.

3.3 MEMBRANE INTERFACE PROBE DATA

At the completion of each hole, a hard copy of the MIP log will be printed and provided to the FST for review. Each MIP log (PID, ECD, EC, and probe temperature) will be given a unique identification number that will define the location of the MIP sampling point. An example of the sample numbering system is:

F20-MIP

where:

F20 = Indicates the AREE 34 grid location (as discussed in Section 3.4); and

MIP = Indicates this is a MIP log.

If additional MIP probes are advanced at a specific location for any reason, they will be designated with a “(2)”, “(3)”, etc. after the grid location [e.g., F20(2)-MIP].

At the end of each day, the MIP logs, and associated DSITMS results, will be E-mailed to Columbia’s main office where they will be normalized, processed, and posted on the secure web-page by the next morning (see Section 8).

3.4 MEMBRANE INTERFACE PROBE LOCATIONS

As discussed in Section 1.2, a series of temporary monitoring wells were installed during the AREE 34 RI, and as shown on Figure 1-6, the temporary monitoring wells were installed on a 10-ft grid system utilizing an alpha-numeric labeling system. "Northeast-southwest" lines were given number designations, and "northwest-southeast" lines were given letter designations. Grid points are referred to by the intersection of the two lines (i.e., A20, K25). The MIP probes will be located on a grid system that will be expanded from the original grid system (see Figure 3-1). The grid system is being expanded to the left of the "A" line. The grid lines to the left of the "A" line will be designated with "double" letters. There will be only one "A" line (i.e., no "AA" line) so that the grid designations will be symmetrical (i.e., KK20 and K20 are equidistant from the "A" line). When implementing the 50% rule described below, it is possible that the MIP will be advanced at locations between major grid points. If this occurs, the MIP locations will be identified using the following examples as guidance:

- If the MIP probe is placed on grid line 25 between grid lines A and BB, designate the location as ABB25;
- If the MIP probe is placed on grid line A halfway between grid lines 24 and 25, designate the location as A24.5; and
- If the MIP probe is placed halfway between grid lines A and BB and halfway between grid lines 24 and 25, designate the location as ABB24.5.

Upon completion of each MIP probe (i.e., probe removed and hole properly sealed), the MIP probe location will be located (latitude and longitude) using a global positioning system (GPS) unit. The location data will be incorporated into the data management system (see Section 8) to help in the evaluation of the high density sampling results.

The first high density sampling point will be located adjacent to saturated overburden monitoring well MW34-4 to assess the degree of contamination at this location, and to establish a benchmark to compare all other high density sample results. The maximum VOC response (which will include the MIP response and/or the sorbent trap response) detected in the MW34-4 MIP probe location will be noted and used to establish the relative difference of the other high density sampling locations. Based on the on-site results of the PDB groundwater samples from saturated overburden monitoring well MW34-4 (see Section 2) and the initial MIP and sorbent trap results at MW34-4, other MIP probes may be advanced near MW34-4 to better define the maximum VOC response. The FST will make that decision after the on-site PDB groundwater sample DSITMS results, MIP real-time data output, and sorbent trap DSITMS results become available.

It is expected that the second high density sampling location will be at grid point F20. This second sampling location (upgradient of MW34-4 with respect to the direction of horizontal groundwater flow in the saturated overburden material) will help establish whether the area of VOC contamination at MW34-4 is small and localized.

The remainder of the high density sampling locations will be determined by the FST based on:

1. The objectives of the FDVCO investigation;
2. Historical data collected from AREE 34;
3. Data collected during this FDVCO investigation; and
4. Their knowledge and experience.

The high density sampling locations will be selected to first attempt to identify whether the VOC contamination at MW34-4 is part of a large expansive area of contamination (see right side of the decision guide presented on Figure 3-2). This includes moving a large distance to a third probe location (KK35) if the VOC responses in the first two locations (F20 and A25) exceed the maximum VOC response at MW34-4 to quickly establish whether the extent of the significant contamination covers a large area upgradient (with respect to the direction of horizontal groundwater flow in the saturated overburden material) of MW34-4. If the area of VOC contamination at or above the MW34-4 maximum VOC response is very large (e.g., diameter greater than 150 ft), the WG will be contacted to discuss possible options.

If the first several probes suggest that the VOC contamination at MW34-4 is small and localized, several other locations will be investigated to confirm that there are no other localized areas of VOC contamination (see the left side of the decision guide presented on Figure 3-2).

Following completion of probes at several designated grid points as indicated on Figure 3-2, sufficient data will be available to begin honing in on the location of the highest VOC response. This will be accomplished using the 50% rule as follows:

- Between two grid points where the more downgradient (with respect to the direction of horizontal groundwater flow in the saturated overburden material) of the two points has a maximum VOC response greater than or equal to the maximum VOC response at MW34-4 and the more upgradient of the two points has a maximum VOC response less than the maximum VOC response at MW34-4, select a grid point that represents approximately 50% of the distance between the two grid points for the next probe location; and
- Continue this methodology until the location of the highest VOC response is identified.

Many of the decisions on the decision guide are based on a determination as to whether the MW34-4 maximum VOC response (or 50% of that response) has been exceeded. The decisions at each point will use that basic criteria, but will not rely solely on the numeric VOC response values. The FST will also consider other criteria when making decisions that might include:

- The results from all previous investigation activities (including MIP, sorbent trap, soil, groundwater, and hydrogeologic data);
- The horizontal distance from the last sampling location and from MW34-4;
- Whether the MIP (and/or sorbent trap) VOC responses (i.e., depth of response, magnitude of response) are similar at the two sampling locations;
- Whether the sorbent trap data indicate similar or different response ratios for the detected VOCs (i.e., if the overall response is the same, but one VOC compound response drops significantly and another compound response increases significantly); or
- Whether some other sampling location other that MW34-4 should be used as the benchmark for comparison purposes (i.e., another sampling location has a higher maximum VOC response than MW34-4).

Although not an objective of the FDVCO investigation, information regarding the extent of VOC contamination upgradient (with respect to the direction of horizontal groundwater flow in the saturated overburden material) of monitoring well MW34-4 would be helpful in refining the CSM. In order to determine the extent of contamination, sampling and analysis would need to continue until non-detect or nearly non-detect VOC concentrations are observed. The FST's ability to determine the extent of contamination during the FDVCO investigation will be limited by the level of field effort for this investigation (i.e., five days in the field) and will depend on the amount of contamination present. Given the fact that the objective of the FDVCO investigation is to identify the highest concentration of VOCs in the overburden soil and groundwater, 50% of the maximum VOC response at MW34-4 has been established as a guide for discontinuing the MIP probes, but is subject to review based on the findings of the investigation as the field effort proceeds.

Shaw will maintain a Decision Log Sheet (included as part of the Daily QC Report; see Section 6.3) that will document the FST's basis for selecting each high density sampling location.

3.5 MEMBRANE INTERFACE PROBE QUALITY ASSURANCE/QUALITY CONTROL

The MIP is a measuring device that provides qualitative or semi-quantitative data regarding the subsurface environmental conditions. Its value is obtaining a very large volume of data that can prove highly valuable for refining CSMs. It is used to help define areas of the subsurface that are contaminated and areas which are not contaminated. It provides a basis for deciding where to collect samples for more rigorous analysis, where to install monitoring systems, and where to focus remediation efforts.

3.5.1 Quality Assurance/Quality Control Procedures and Acceptance Criteria

When using the MIP, the SOP published by the Geoprobe® manufacturer (see Appendix A) will be followed. The major goal of QA/QC procedures is to ensure that the system is stable and reproducible. This is best done by ex situ testing at the surface. In situ tests such as the comparison of adjacent logs, although of interest, typically reflect a combination of subsurface heterogeneity and instrument response variability.

One of the advantages of using a real-time sensor system is that QC can be designed to proactively address specific sampling and analytical uncertainties to ensure that all data collected is of known and documented quality. This ongoing review provides a powerful QC check on the MIP data being collected as well as on the evolving CSM, while the team is still in the field.

Instrument stability and reproducibility checks are routinely done by conducting performance tests (PTs) and by documenting the change over time. A PT should be run before and after each logging event, after system component replacement, and when the system has been idle for 3 hours or more. The PT procedures involve the following:

1. Prepare standard of compound(s) of interest;
2. Immerse probe into bucket of clean water to stabilize the baseline;
3. Check for stability of detector versus time data on MIP software;
4. Insert probe into test solution of known concentration for 45 seconds;
5. Return probe to clean water bucket;
6. Record trip time and response time in field notes; and
7. Compare results to previous measurements.

The acceptance criteria for these tests is +/-50%. If response changes exceed +/-50%, corrective action is required. Records will also be kept of flow rates, probes used, membrane changes, all operating changes, and other conditions that may affect the results.

In addition to conducting PTs and monitoring these parameters, the following actions will be taken to ensure that the data produced are of known quality:

1. Membranes will be replaced whenever the flow rates indicate the membranes are smeared closed or cut open;
2. Transfer lines will be replaced or purged whenever evidence of significant carryover appears on the logs to the point of the background becoming so high that the data are not useable;
3. Probes will be replaced whenever they do not maintain adequate temperatures; and
4. Detectors will be replaced whenever they do not respond appropriately to PTs.

Columbia will also evaluate on a continuous and real-time basis the internal consistency of all of the data sets being collected. For instance, the MIP collects up to six channels of data at a time as discussed in Section 3.0. The three chemical data sets can be compared and contrasted to determine if any one or more of them are responding in a normal or abnormal manner. The chemical data sets can also be compared to the EC, penetration rate, and temperature data sets. Any anomalies that are detected will be assessed to see if there is a problem in the data collection system. Probing will stop until the problem has been fixed or adequately noted.

The real-time evaluation of the compatibility of incoming data sets against the current CSM will also be performed. The MIP data can be compared against existing hydrogeological information as well as analytical data. If discrepancies occur, these can often be tested by immediately collecting additional information with a carefully placed MIP profile in a place that will provide additional information for the

CSM. The ability to do this in real time provides a powerful QC check and evaluates the reliabilities of both the MIP and the CSM while the team is still in the field.

3.5.2 Corrective Action

If the PT records reveal a change of greater than 50% from the initial reading, then the data set needs to be reviewed and the system evaluated. The system will be evaluated for leaks, blockages, detector malfunctioning, and data system and wiring problems. After these are checked, another PT will be conducted. If the PT records still reveal a change of greater than 50% from the initial reading, options will be discussed with the WG.

3.5.3 Operating Protocol Changes and Enhancements

The MIP operator may from time to time adjust flow rates, hold times, or other operating variables to enhance the data that is collected. If any of these changes occur, they will be documented.

4.0 COLLABORATIVE SOIL AND GROUNDWATER SAMPLING

At the discretion of the FST, overburden soil and/or groundwater samples may be collected during, or after, the high density sampling activities to collaborate the MIP and/or sorbent trap results. The FST will decide where and when to collect such samples based on the considerations presented in Sections 4.1.2 and 4.2.3.

Collaborative soil samples will be collected using a Geoprobe® drill rig, and temporary monitoring wells for collaborative groundwater sample collection will be installed in boreholes drilled using the Geoprobe® drill rig. Columbia will operate the Geoprobe® drill rig and install the temporary monitoring wells under the supervision of Shaw's senior hydrogeologist. Tri-Corders will collect the collaborative soil samples for on-site analysis from the soil cores, Shaw will collect the collaborative soil samples for off-site analysis from the soil cores, and Shaw will collect the collaborative groundwater samples from the temporary monitoring wells. Tri-Corders will analyze collaborative soil and groundwater samples for VOCs using the on-site DSITMS (see Section 5). For collaborative soil and groundwater samples that the FST identifies for off-site laboratory analysis, Shaw will arrange for the off-site laboratory analysis of the samples, and will package and ship the samples to the off-site laboratory (see Section 6).

Soil and/or groundwater sampling, as described in this section, may also be conducted at locations where the MIP results (see Section 3) do not appear to meet project data collection objectives. For example, this could occur if the MIP, with or without the sorbent traps, is not capable of collecting the data to determine if VOCs are present at a particular location due to limitations associated with VOC detection limits. By initially probing at a location of known VOC contamination (i.e., saturated overburden monitoring well MW34-4), the FST will be able to evaluate the effectiveness of the MIP for meeting the project objectives at this site. The PDB groundwater samples collected from MW34-4 will be collected and analyzed for VOCs using the on-site DSITMS on the first day of the field effort. These data will provide the FST a feel for the order of magnitude of VOC contamination present for comparison with the MIP and sorbent trap results. If the MIP and sorbent trap data do not indicate detectable levels of VOCs, that is indicative that an alternative approach may be required. Before such a decision is made, the FST may probe a few more locations since it is possible that higher levels of VOCs may exist upgradient (with respect to the direction of horizontal groundwater flow in the saturated overburden material) of MW34-4. If the MIP and sorbent traps still do not detect VOCs, the MIP/sorbent trap sampling will be terminated, and refinement of the CSM will proceed by collecting soil and/or temporary monitoring well groundwater samples which will be analyzed for VOCs using the on-site DSITMS, and possibly for TCL VOCs by the off-site laboratory at the discretion of the FST. In the event this situation occurs, the selection of sampling locations will follow the approach presented in the decision guide (Figure 3-2). If at any point VOC contamination significantly higher than that found at MW34-4 is detected using soil and/or groundwater samples, the FST may make the decision to use the MIP and sorbent trap tools once again. The FST will document the rationale for switching from MIP/sorbent trap sampling to soil/groundwater sampling, and vice versa, if conditions warrant.

Although the remainder of this section focuses on the use of soil and groundwater samples to collaborate the high density data, the FST will continually evaluate the effectiveness of the high density sampling program and consider the alternative of using soil and/or groundwater samples alone as necessary to meet project objectives.

4.1 COLLABORATIVE SOIL SAMPLES

Soil samples may be collected and analyzed for VOCs using the on-site DSITMS (see Section 5.2.2), based on the decision of the FST, to collaborate the MIP and/or sorbent trap results from the high density sampling (see Section 3). Collaborative soil samples will be collected using a Geoprobe® drill rig. The FST will document the rationale for both the location and depth of the collaborative soil samples.

4.1.1 Geoprobe® Drilling Technique

Drilling activities will be conducted in accordance with the USACE Monitor Well Design, Installation, and Documentation at Hazardous and/or Toxic Waste Sites (USACE, 1994a) to ensure the safety of drilling personnel and the integrity of the samples. As noted in Section 3, Shaw will arrange for clearance of underground utilities prior to initiation of the high density sampling. All drilling activities will be performed under the direct supervision of Shaw's senior hydrogeologist.

A fully-equipped Geoprobe® drill rig equipped with push-rods, points, 4-ft long acetate liners, and a 4-ft long stainless steel Macrocore sampler will be used to drill soil borings at AREE 34. Geoprobe® drilling does not employ the use of any drilling fluids. The following procedures will be followed in preparation for Geoprobe® drilling of boreholes:

a. Prior to its initial use (and at the end of the field work), the Geoprobe® drill rig and all drilling equipment will be decontaminated according to the procedures detailed in Section 9.2. The decontaminated, stainless steel Macrocore sampler, drill rods, and other downhole equipment will be wrapped in clean plastic sheeting and transported to the site. The resulting decontamination water will be managed as indicated in Section 10.1.

b. Plumbness will be obtained in each borehole by careful leveling of the drill rig prior to commencement of drilling. The borehole will be maintained in a plumb and true condition during drilling by sustaining a drilling speed that will be sufficiently low to prevent deviation of the borehole. In addition, drilling will proceed in an efficient and controlled manner to eliminate wandering of the stainless steel sampler.

Following these initial setup procedures, continuous subsurface soil samples will be collected from each borehole at discrete 4-ft intervals using the Macrocore sampler until the desired depth for collaborative soil sample collection is reached. The Macrocore sampler is a two-inch outside diameter (O.D.) by 4-ft long sampler that utilizes clear acetate liners to help ensure sample integrity and sample removal from the device. Once removed from the borehole and the Macrocore sampler, the acetate liners will be opened, and the soil will be screened with a PID. A new acetate liner will be placed in the Macrocore sampler for every 4-ft sample collected. Each borehole will be advanced until the desired depth (established by the FST) is reached. If refusal is encountered within 5 ft of the ground surface, the Geoprobe® rig may be moved a few feet and a new borehole advanced. Shaw's senior hydrogeologist will monitor each 4-ft sample with a PID, and record the reading on the boring log to further assist in the evaluation of vertical extent of contamination. Before moving to the next borehole location, all downhole tools will be decontaminated using the procedures described in Section 9.3. The Macrocore sampler will not require decontamination between each use within a single borehole since a new acetate liner will be used for collection of each 4-ft soil sample.

Shaw's senior hydrogeologist will log the drilling and sampling activities associated with each subsurface soil boring on an original boring log. The following information, where applicable or available, will be recorded on the boring logs during the course of the drilling and sampling activity:

a. Depths of the boring in feet and fractions thereof (tenths of feet);

b. Soil descriptions, in accordance with the Unified Soil Classification System (USCS), including:

    1. Classification,
    2. USCS symbol,
    3. Secondary components and estimated percentage,
    4. Color (using the Muncell Soil Color Chart, or equivalent),
    5. Plasticity,
    6. Consistency (cohesive soil) or density (non-cohesive soil),
    7. Moisture content,
    8. Texture/fabric/bedding, and
    9. Grain angularity;

c. Cutting descriptions, including basic classification, secondary components, and other notable features;

d. Numerical, visual estimates of secondary soil constituents (if terms such as “trace”, “some”, or “several” will be used, their quantitative meanings will be defined in a general legend);
e. Length of sample recovered in the Macrocore sampler (percent recovery);
f. Blow counts, where applicable;
g. Depth interval for each sample;
h. Depth to water first encountered during drilling and the method of determination (any distinct water-bearing zones below the first zone will also be noted);
i. General description of the drilling equipment used, including the rod size, bit type, pump type, rig manufacturer, model, and names of drilling personnel;
j. Drilling sequence;
k. Any unusual problems;
l. Start and completion dates of borings, and a chronological time-sequence of events;
m. Lithologic boundaries;
n. Fluid losses, where applicable;
o. Soil boring identification number and location;
p. Rock type, where applicable; and
q. PID readings.

All soil cuttings and acetate liners generated as a result of drilling activities at AREE 34 will be drummed, labeled, and transported to the former Army, Air Force Exchange System (AAFES) Service Station to await off-site disposal based on waste characterization data to be collected as part of a subsequent field investigation at AREE 34. Disposal of soil cuttings is described in Section 10.3.

Each borehole will be abandoned using 3/8-inch diameter bentonite pellets hydrated with USACE-approved water (unchlorinated water from Production Well No. 3). Bentonite pellets will be poured in from the ground surface to seal the entire length of the borehole. Where a borehole has penetrated through asphalt, the top four inches of the hole will be backfilled with asphalt patch material and compacted. The asphalt patch will be packed in as solidly as possible to avoid future settling into small pockets that would allow water and ice to degrade the asphalt.

Upon abandonment of each borehole drilled for collaborative soil sample collection, the borehole location will be located (latitude and longitude) using a GPS unit.

4.1.2 Collaborative Soil Sample Locations

The MIP sample vapor stream will be monitored both continuously (PID and ECD) and using sorbent traps to integrate 5 ft (or shorter) sample intervals. As described in Section 3, VOC analysis of the sorbent traps will be conducted using the on-site DSITMS. The MIP is capable of in situ sampling of high levels of VOC contaminants. However, the data produced by MIP sampling is semi-quantitative because the MIP samples the bulk soil matrix (soil and groundwater). Additionally, the MIP has been demonstrated to be subject to soil matrix effects.

Discrete collaborative soil samples may be collected to collaborate VOC responses detected by the MIP and/or in the sorbent traps and to provide data to support refinement of the CSM (as updated by the MIP data). Further, the analytical results for the collaborative soil samples may provide an understanding of the magnitude of contamination associated with the observed range (i.e., low, medium, and high) of MIP and sorbent trap VOC responses in concentration units that are well understood (i.e., micrograms per kilogram [µg/kg]). Such collaborative soil sampling could prove helpful in the early stages of the high density sampling program.

The need for, frequency of, location of, and depth of collaborative soil samples will be determined by the FST based on a combination of the MIP data (see Section 3), the sorbent trap results (see Section 3), the PDB groundwater sample results (see Section 2), and the results of any temporary monitoring well collaborative groundwater samples (see Section 4.2) or discrete collaborative soil samples already collected and analyzed. Circumstances under which discrete collaborative soil samples may be collected for on-site DSITMS analysis (see Section 5.2.2) include, but are not limited to, the following:

- Adjacent to the initial MIP penetration at MW34-4 at depths where the MIP indicates contamination to collaborate the MIP results and to identify the magnitude (if any) of soil matrix effects on MIP response;
- Adjacent to additional MIP penetrations at depths where the MIP EC sensor indicates the presence of VOC contaminants in strata other than those identified and analyzed adjacent to MW34-4 to identify the magnitude (if any) of soil matrix effects on MIP response;
- In relatively narrow zones identified by high MIP VOC response (continuous or sorbent trap) in order to better define subsurface intervals of VOC contamination; and
- At other locations and depths determined by the FST to further refine the CSM.

Based on soil data from previous on-site investigations, the results of the high density sampling program, and the DSITMS results for the collaborative soil and/or groundwater samples analyzed on site, the FST will determine if any soil samples should be sent for off-site laboratory analysis and, if soil samples are collected for off-site laboratory analysis, the locations and depths of those samples. It is anticipated that if soil samples are collected for off-site laboratory analysis that they will be collected at the locations with the highest VOC responses from the MIP and sorbent traps or the highest VOC concentrations from the collaborative soil samples analyzed on site by the DSITMS. Should any soil samples be sent for off-site laboratory analysis, they will be used to evaluate the human health risk associated with the VOC contamination in the overburden soil at AREE 34.

The FST will document the rationale for the location and depth for each collaborative soil sample as well as the rationale for whether the samples are analyzed on site or off site. Up to ten soil samples, including associated field QC samples (see Section 4.1.4), will be sent to the off-site laboratory for analysis of TCL VOCs as part of the FDVCO investigation. If no soil samples are sent for off-site laboratory analysis, the FST will document the rationale for this decision. Field decisions will be documented on a Decision Log Sheet (included as part of the Daily QC Report; see Section 6.3).

4.1.3 Soil Sample Collection and Handling Procedures

Discrete collaborative soil samples will be collected directly from the soil cores produced by the Macrocore sampling device. Once the Macrocore sampler has been removed from the borehole, the Macrocore sampler and acetate liner have been opened, and the soil core has been screened with a PID, the collaborative soil sample can be collected. Different procedures will be used for collaborative soil sample collection depending on whether the soil sample is to be analyzed on site using the DSITMS (see Section 4.1.3.1) or the soil sample is to be analyzed off site (see Section 4.1.3.2).

4.1.3.1 Soil Sample Collection and Handling Procedures for On-site DSITMS Analysis

Tri-Corders will collect the collaborative soil samples that will be analyzed on site using the DSITMS following a modified USEPA SW-846 Method 5035 (see Appendix C). Collaborative soil samples for on-site analysis will be collected using a reusable plastic 10 mL syringe (decontaminated between samples) with the tip removed. The syringe is used as a sub-sampling device to collect a soil sample from the soil core. The syringe will be pushed into the soil core at the desired location to collect approximately 5 mL of soil. Immediately upon collection, Tri-Corders will place the collected soil sub-sample into a VOA vial containing an extraction solvent (distilled water for low-level samples and methanol for high-level samples) as described in Section 5.2.2. Therefore, it is not necessary for the syringe to be capped or sealed. Detailed soil sampling procedures for on-site DSITMS VOC analysis are presented in Appendix C.

4.1.3.2 Soil Sample Collection and Handling Procedures for Off-site Laboratory Analysis

Shaw will collect the collaborative soil samples that will be analyzed off site for TCL VOCs. Collaborative soil samples for off-site analysis will be collected using 5-gram En Core® samplers. Three

En Core® samplers will be filled for each collaborative soil sample for off-site laboratory analysis. Each En Core® sampler will be filled using the following procedure:

1. Push the plunger rod down until the small O-ring rests against the tabs.
2. Release the locking lever on the En Core® T-Handle and place the coring body, plunger end first, into the open end of the T-Handle, aligning the two coring body slots with the two locking pins in the T-Handle.
3. Push the T-Handle into the soil until the coring body is completely full (i.e., O-ring is centered in the T-Handle viewing hole).
4. Cap the coring body while it remains in the T-Handle. The locking arm grooves on the cap must be fully seated over the coring body ridge for a proper seal.
5. Remove the capped En Core® sampler by depressing the locking lever on the T-Handle while twisting and pulling the En Core® sampler from the T-Handle.
6. Lock the plunger by turning the extended plunger rod fully counter-clockwise until the wings rest fully against the tabs.

Soil samples collected using En Core® samplers must be extracted by the off-site laboratory within 48 hours of sample collection. Therefore, soil samples for off-site analysis will be packaged and shipped to the off-site laboratory (see Section 6) on the day of sample collection.

4.1.3.3 Collaborative Soil Sample Identification

Each collaborative soil sample will be given a unique field sample number that will identify the location and depth of the sample. An example of the field sample numbering system is:

F20-SB-16.5

where:

F20 = Indicates the AREE 34 grid location (as discussed in Section 3.4);

SB = Indicates this is a collaborative soil sample from a soil boring; and

16.5 = Indicates the depth of the soil sample (ft bgs).

If additional soil borings are advanced at a specific location for any reason, they will be designated with a "(2)", "(3)", etc. after the grid location [e.g., F20(2)-SB-16.5]. Each collaborative soil sample will be recorded in the field logbook, on the boring log, and on the Sample Collection Log Sheet (included as part of the Daily QC Report; see Section 6.3) whether it is analyzed for VOCs on site using the DSITMS or analyzed for TCL VOCs off site.

Collaborative soil samples for on-site DSITMS analysis will immediately be extracted and analyzed for VOCs by Tri-Corders using the on-site DSITMS (see Section 5.2.2). Collaborative soil samples for off-site laboratory analysis will be kept on ice at the site to maintain a temperature of 4±2°C until the samples are shipped off site for TCL VOC analysis by the off-site laboratory (see Section 7). For collaborative soil samples to be analyzed for TCL VOCs off site, En Core® samplers will be packaged and shipped as discussed in Section 6.

4.1.4 Field Quality Control for Collaborative Soil Samples

Since soil samples for VOC analysis are not homogenized, "duplicate" soil samples cannot be collected to assess sampling precision. However, co-located soil samples will be collected to provide an indication of the variability associated with matrix heterogeneity. Co-located soil samples will be collected from the same core as, and as close to the location of, the primary sample as possible. Co-located soil samples will be collected at a frequency of 10% (i.e., one co-located soil sample for every 10 primary samples) for both on-site and off-site collaborative soil samples. Each co-located soil sample will be analyzed using the same method that is used for analysis of the corresponding primary sample. Co-located soil samples will have the same field sample number as the primary samples with a "C" added at the end (e.g., F20-SB-16.5C).

The collaborative soil samples for on-site analysis will be collected utilizing reusable syringes. The syringes will be decontaminated between samples. To assess the potential for cross-contamination between samples as a result of sampling equipment decontamination procedures, one equipment rinse blank (designated Emmddyy) will be collected for each day that collaborative soil samples are collected for on-site DSITMS analysis. Equipment rinse blanks are prepared by pouring deionized, organic-free water over the decontaminated syringe and into two unpreserved 40-mL VOA vials. Equipment rinse blanks will be analyzed for VOCs using the on-site DSITMS.

The collaborative soil samples for off-site analysis will be collected utilizing En Core® samplers that are dedicated sampling devices. Since each sample will be collected with a new En Core® sampler and no decontamination is required, cross-contamination between samples as a result of sampling equipment decontamination procedures is not an issue. Therefore, equipment rinse blanks will not be collected.

Trip blanks are not required for solid samples and, therefore, will not accompany collaborative soil samples sent to the off-site laboratory for analysis.

Field QC samples will be documented on the Sample Collection Log Sheet (all samples) and/or on the COC form (off-site samples only) (see Section 6).

4.2 COLLABORATIVE TEMPORARY MONITORING WELL GROUNDWATER SAMPLES

Collaborative groundwater samples may be collected from temporary monitoring wells installed using a Geoprobe® drill rig. The FST will specify the exact location, depth and screen length for each temporary monitoring well. The FST will also determine whether the samples will be analyzed on site by the DSITMS, or be shipped off site for analysis by the off-site laboratory. The FST will document the rationale for the location, depth, and screened interval for each temporary monitoring well as well as the rationale for whether the samples are analyzed on site or off site.

4.2.1 Geoprobe® Drilling Technique

The Geoprobe® drill rig, downhole equipment, and drilling technique that will be used to install the temporary monitoring wells is presented in detail in Section 4.1.1.

4.2.2 Temporary Monitoring Well Construction and Installation

Temporary monitoring wells will be constructed using flush-threaded, Schedule 40,1-inch inside diameter (I.D.), PVC casing and well screen. A 0.01-inch slot size well screen will be used to construct each temporary monitoring well. Actual screen length will be determined by the FST based on the high density sampling. The PVC materials will conform to National Sanitation Foundation Standard 14 for potable water usage or American Society for Testing and Materials (ASTM) equivalent. The well screen and casing will be decontaminated following procedures outlined in Section 9.4 prior to transportation to the drill site. No plastic solvents or glues will be used on any of the well materials.

The filter pack will consist of sieve size 20/40 silica sand. This size is compatible with both the screen slot size and the overburden materials.

The bentonite seal will consist of bentonite pellets installed over the filter pack. Once installed at the proper depth, the bentonite seal will be allowed to hydrate. No grout will be used in the temporary monitoring well construction.

Because the temporary monitoring wells will be in place for only a few days, no protective covers will be installed over them. Instead, empty, clean 55-gallon drums (or equivalent) will be placed, upside down, over the wells until they are sampled and removed.

The temporary monitoring well installation will proceed immediately after reaching the depth specified by the FST and upon removal of the Macrocore sampler from the borehole, and, once begun, will continue uninterrupted until the bentonite seal is installed. Shaw’s senior hydrogeologist will confirm the depth of the borehole with a weighted tape before the temporary monitoring well screen and casing are installed.

After attaching a bottom cap to the well screen, each decontaminated casing section will be threaded to the section immediately below it and lowered into the boring. Clean latex gloves will be worn at all times during the handling of the well screen and casing.

Filter pack (a.k.a., sand pack) installation will be accomplished by pouring sand in from the ground surface, down the annulus, and along the outside of the well screen and casing. The filter pack will be generally installed to a height at least two feet above the top of the well screen, unless directed otherwise by Shaw's senior hydrogeologist. The height of the filter pack will be verified using a weighted tape during installation to ensure proper sand placement.

The bentonite seal will consist of bentonite pellets installed directly over the top of the filter pack. Pellets will be poured in from the ground surface. Each bentonite seal will have a thickness of at least one foot, as measured immediately after placement.

Upon completing the installation of each temporary monitoring well, the location of the well will be located (latitude and longitude) using a GPS unit.

The temporary monitoring wells will not be developed because of the anticipated slow recovery of the temporary monitoring wells (based on recovery rates of previously installed temporary and permanent monitoring wells at AREE 34) and the necessity to collect samples within a short time frame. The temporary monitoring wells are meant to provide relative differences in VOC concentrations in the groundwater, unlike permanent groundwater monitoring wells that, when properly installed and sampled, provide results that can be compared to regulatory criteria and used in risk assessment.

After providing an acceptable groundwater sample, the temporary monitoring well screen and casing will be pulled straight out of the ground by hand or using the Geoprobe® rig (as needed). The FST may choose to leave the temporary monitoring wells in place until the end of the FDVCO investigation so that additional groundwater samples can be collected at the FST's discretion. The temporary monitoring wells will remain in the ground for no more than seven days.

Temporary monitoring well materials that are lifted to the surface will be containerized in 55-gallon drums, labeled, and transported to the former AAFES Service Station to await off-site disposal based on waste characterization data to be collected as part of a subsequent field investigation at AREE 34. Disposal of the temporary monitoring well materials is described in Section 10.2.

Each temporary monitoring well borehole will be abandoned using 3/8-inch diameter bentonite pellets hydrated with USACE-approved water (unchlorinated water from Production Well No. 3). Bentonite pellets will be poured in from the ground surface to seal the entire length of each borehole. Where a borehole has penetrated through asphalt, the top four inches of the hole will be backfilled with asphalt patch material and compacted. The asphalt patch will be packed in as solidly as possible to avoid future settling into small pockets that would allow water and ice to degrade the asphalt.

4.2.3 Temporary Monitoring Well Locations

As discussed in Section 4.1.2, discrete soil sampling and VOC analysis using the on-site DSITMS may be used to collaborate the MIP data in relatively narrow zones of subsurface contamination. A more homogeneous zone of contamination detected by the MIP (several feet in thickness) would suggest that the contamination is occurring in the dissolved phase (i.e., groundwater). Therefore, collaborative sampling of the MIP and sorbent trap results in this situation would consist of collecting a groundwater sample (see Section 4.2.4) and analyzing the sample for VOCs using the on-site DSITMS (see Section 5.2.3).

Collaborative groundwater samples may be collected from temporary monitoring wells, installed using a Geoprobe® drill rig, to collaborate VOC responses detected by the MIP and/or in the sorbent traps and to provide data to support refinement of the CSM (as updated by the MIP data). Further, the analytical results for the collaborative groundwater samples may provide an understanding of the magnitude of contamination associated with the observed range (i.e., low, medium, and high) of MIP and sorbent trap VOC responses in concentration units that are well understood (i.e., μg/L). Such collaborative groundwater sampling could prove helpful in the early stages of the high density sampling program as well as at the end of the FDVCO field investigation.

The need for, frequency of, location of, and depth interval (i.e., depth and screened interval for the temporary monitoring well) of collaborative groundwater samples will be determined by the FST based on a combination of the MIP data (see Section 3), the sorbent trap results (see Section 3), the PDB groundwater sample results (see Section 2), and the results of any discrete collaborative soil samples (see Section 4.1) or temporary monitoring well groundwater samples already collected and analyzed. Circumstances under which collaborative groundwater samples may be collected for on-site DSITMS analysis (see Section 5.2.3) include, but are not limited to, the following:

- In broad zones identified by high MIP VOC response (continuous or sorbent trap) in order to better define VOC contamination in the saturated overburden groundwater;
- In zones identified by both low and high MIP VOC response (continuous or sorbent trap) in order to help justify whether or not additional permanent saturated overburden monitoring wells are needed and where they should be placed; and
- At other locations and depths determined by the FST to collaborate the CSM.

Based on groundwater data from previous on-site investigations, the results of the high density sampling program, and the DSITMS results for the collaborative soil and/or groundwater samples analyzed on site, the FST will determine if any temporary monitoring well groundwater samples should be sent for off-site laboratory analysis and, if groundwater samples are collected for off-site laboratory analysis, the locations and depth intervals of those samples.

The FST will document the rationale for the location, depth, and screened interval for each temporary monitoring well as well as the rationale for whether the associated collaborative groundwater samples are analyzed on site or off site. Up to 15 groundwater samples, including associated field QC samples (see Section 4.2.5) and off-site PDB groundwater samples (see Section 2), will be sent to the off-site laboratory for analysis of TCL VOCs as part of the FDVCO investigation. If no groundwater samples are sent for off-site laboratory analysis, the FST will document the rationale for this decision. Field decision will be documented on a Decision Log Sheet (included as part of the Daily QC Report; see Section 6.3).

4.2.4 Temporary Monitoring Well Groundwater Sample Collection and Handling Procedures

A groundwater sample from each temporary monitoring well will be collected for either on-site analysis of VOCs using the DSITMS (see Section 5), off-site laboratory analysis for TCL VOCs (see Section 7), or both. The FST will determine where the samples will be analyzed.

Temporary monitoring wells will be sampled using disposable ½-inch I.D., 3-ft long polyethylene bailers no sooner than one hour after installation of the temporary monitoring well. A new bailer will be used to sample each temporary monitoring well. Bailers have been selected for collecting groundwater samples from the temporary monitoring wells for the following reasons: 1) the limited volume of groundwater expected to be present in the temporary monitoring wells based on past experience during the AREE 34 RI field work makes pumping infeasible; and 2) analytical results for temporary monitoring well groundwater samples collected using bailers during the AREE 34 RI were found to correlate well with analytical results for groundwater samples collected from permanent monitoring wells using the low-flow sampling method (USACE, 2003a). There will be no pre-sample purging because of the anticipated slow recovery of the temporary monitoring wells (based on recovery rates of previously installed temporary and permanent monitoring wells at AREE 34) and the necessity to collect samples within a short time frame. Since there will be no pre-sample purging, there will be no monitoring of field stabilization parameters (temperature, pH, conductivity, redox, DO, and turbidity). The following groundwater sampling procedures will be followed:

1. A clean piece of plastic sheeting will be spread on the ground around the well to protect the sampling equipment from possibly becoming contaminated.
2. Headspace readings in the well and in the breathing zone immediately above the well will be taken with a PID.
3. If VOCs are measured in the well with the PID, the well will be allowed to ventilate for several minutes. If all PID readings are less than 1 ppm in the samplers' breathing zone, Level D

PPE will be worn while sampling the well. If the PID readings are continuous (exceeding 1 ppm but not greater than 5 ppm) in the samplers' breathing zone, then Level C PPE will be worn while sampling the well. If the PID readings are continuous above 5 ppm in the samplers' breathing zone, the site will be evacuated.

4. The depth to water will be measured, with an electric water level indicator with an accuracy of 0.01 ft, from the top of the PVC casing and recorded in the field logbook. The tape and probe will be decontaminated between measurements at different wells, as discussed in Section 9.5.
5. The approximate height of the water column will be calculated based on the installed total depth of the temporary monitoring well. A minimum water column height of 2 ft will be required to provide sufficient volume of water to fill the sample containers.
6. The disposable bailer will be slowly lowered into the well until it is at the mid-point of the screened interval or at the mid-point of the water column if the static water level is below the top of the well screen.
7. The bailer will then be slowly removed from the well, and the sample containers (five 40-mL VOA vials) will be filled. Two of the VOA vials will not contain any preservative (7-day holding time), and the other three VOA vials will be preserved to a pH of <2 with HCl (14-day holding time). The VOA vials will be filled slowly to minimize air bubbles and agitation of the sample. The VOA vials will be filled with zero headspace.
8. Sample bottles will be labeled, enclosed in a plastic bag, and placed in a cooler maintained at 4±2°C immediately after sample collection and preservation.
9. The field sample number, number of sample containers, sample container type, and sample preservation method will be recorded on the Sample Collection Log Sheet (included as part of the Daily QC Sheet; see Section 6.3).

Disposable sampling equipment will be discarded as discussed in Section 10.2. Any excess sample water remaining in the bailers will be containerized in a 55-gallon drum and disposed with the decon water from the FDVCO investigation as discussed in Section 10.1.

Each temporary monitoring well groundwater sample will be given a unique field sample number that will identify the sample location and the screen interval of the temporary monitoring well. An example of the field sample numbering system is:

F20-TW-(8.5-18.5)

where:

F20 = Indicates the AREE 34 grid location (as discussed in Section 3.4);
TW = Indicates this is a temporary monitoring well sample; and
(8.5-18.5) = Indicates the screen interval of the temporary monitoring well (ft bgs).

If additional groundwater samples are collected from a specific temporary monitoring well for any reason, they will be designated with a "(2)", "(3)", etc. after the grid location [e.g., F20(2)-TW-(8.5-18.5)]. Each collaborative temporary monitoring well groundwater sample will be recorded in the field logbook and on the Sample Collection Log Sheet (included as part of the Daily QC Sheet; see Section 6.3) whether it is analyzed for VOCs on site using the DSITMS or analyzed for TCL VOCs off site.

All temporary monitoring well groundwater sample bottles will be kept on ice at the site to maintain a temperature of 4±2°C until the samples are analyzed for VOCs by Tri-Corders using the on-site DSITMS (see Section 5.2.3), shipped off site for TCL VOC analysis by the off-site laboratory (see Section 7), and/or discarded. The unpreserved sample aliquots will be used for the on-site VOC analysis since the samples will be analyzed on the day they are collected, or the following day at the latest. If off-site laboratory analysis is to be conducted, the preserved sample aliquots will be used for this purpose. For temporary monitoring well groundwater samples to be analyzed for TCL VOCs off site, sample bottles will be packaged and shipped as discussed in Section 6.

4.2.5 Field Quality Control for Temporary Monitoring Well Groundwater Samples

Field duplicate temporary monitoring well groundwater samples will be collected to provide an indication of the variability associated with matrix heterogeneity and to assess sampling precision. Field duplicate temporary monitoring well groundwater samples will be collected at a frequency of 10% (i.e., one field duplicate for every 10 primary samples) for both on-site and off-site collaborative groundwater samples. Each field duplicate temporary monitoring well groundwater sample will be analyzed using the same method that is used for analysis of the corresponding primary sample. Duplicate temporary monitoring well groundwater samples will have the same field sample number as the primary samples with a “D” added at the end [e.g., F20-TW-(8.5-18.5)D].

Equipment blanks will not be collected since dedicated disposable bailers will be used to sample the temporary monitoring wells. Since each sample will be collected with a new bailer and no decontamination is required, cross-contamination between samples as a result of sampling equipment decontamination procedures is not an issue.

Daily field blanks (designated as Fmmddyy) will be prepared by pouring deionized, organic-free water into two unpreserved 40-mL VOA vials. Field blanks will be analyzed for VOCs using the on-site DSITMS to identify contamination from exposure to atmospheric contaminants.

In addition to field duplicates, field QC samples associated with the collaborative groundwater samples being shipped off site for laboratory analysis will include trip blanks. Trip blanks are intended to identify contamination from exposure to atmospheric contaminants that may occur during various stages of the sampling process including: shipment of bottles to the site; storage of bottles on site; collection of samples on site; storage of samples on site; shipment of samples to the laboratory; and storage of samples at the laboratory. Trip blanks (designated as Tmmddyy) will accompany collaborative groundwater samples to the off-site laboratory and will be analyzed for TCL VOCs by the off-site laboratory. The trip blanks will be prepared by the off-site laboratory, shipped to the site along with the sample bottles, and shipped back to the laboratory with the samples.

Field QC samples will be documented on the Sample Collection Log Sheet (all samples) and/or on the COC form (off-site samples only) (see Section 6).

5.0 ON-SITE DIRECT SAMPLING ION TRAP MASS SPECTROMETER ANALYSIS

Tri-Corders will mobilize their DSITMS to AREE 34 for on-site analysis of PDB groundwater samples (Section 2), sorbent traps (Section 3), collaborative soil samples (Section 4.1), and collaborative groundwater samples (Section 4.2) for VOCs. The DSITMS will be housed in a fully-equipped enclosed trailer pulled by a supply truck. Since the DSITMS may be used for analysis of sorbent traps, soil samples, and groundwater samples on any given day, Tri-Corders will begin each day by calibrating the DSITMS for each of these media.

5.1 DIRECT SAMPLING ION TRAP MASS SPECTROMETER EQUIPMENT

The analysis of samples for VOCs by DSITMS is based upon SW-846 Method 8265 (see Appendix C). DSITMS is a very rapid method for the detection and quantification of VOC contaminants of concern. The technique consists of a set of sampling interfaces that allow the introduction of vapor samples containing VOCs directly into an ion trap mass spectrometer. As opposed to a gas chromatograph/mass spectrometer (GC/MS) instrument, the DSITMS approach does not separate analytes into individual components before detection by mass spectrometry. The DSITMS introduces all VOCs present in a sample into the mass spectrometer as a mixture. The DSITMS depends on the uniqueness of each compound's mass spectra for both identification and quantification.

DSITMS is well suited for the rapid quantitative measurement, continuous real-time monitoring, and qualitative and quantitative preliminary analysis of VOCs in water, soil, soil gas, and air. DSITMS introduces sample materials directly into an ion trap mass spectrometer by means of a simple interface (such as a capillary restrictor). There is little if any sample preparation and no chromatographic separation. The response of the instrument to analytes in a sample is nearly instantaneous. In addition, the instrument is field transportable, rugged, and relatively easy to operate and maintain.

5.2 DIRECT SAMPLING ION TRAP MASS SPECTROMETER OPERATION

The DSITMS will be used during this project to analyze a variety of matrices for VOC contaminants of concern. These matrices include vapor samples collected on sorbent traps from the MIP, discrete soil samples, and discrete groundwater samples.

Tri-Corders' SOPs and QA Plan for DSITMS analysis of sorbent traps, soil samples, and groundwater samples are included in Appendix C. These SOPs are an integral part of this FDVCO-WP and provide details regarding operation and instrument output. The SOPs describe the procedures for the analysis of sorbent traps, discrete soil samples, and discrete groundwater samples. This includes the procedures for analysis of discrete soil samples by both low-level (slurry preparation) and high-level (methanol extraction). These documents together specify calibration requirements, analysis procedures, QC sample analysis, and corrective actions. Frequency of QC check samples are presented in the SOPs and are generally specified at 5% at a minimum. The DSITMS will be calibrated for the VOC contaminants of concern at AREE 34 based on the results of the AREE 34 RI and SRI (USACE, 2003a; 2003b). The DSITMS will be calibrated for CCl_4, chloroform, 1,1-DCE, cis-1,2-dichloroethene (cis-1,2-DCE), PCE, 1,1,2-TCA, and TCE. The main limitation of the DSITMS is that any compounds having the same ions are reported as an analyte pair or sum (e.g., 1,1-DCE and cis/trans-DCE). This limitation is discussed in USEPA SW-846 Method 8265 (see Appendix C).

Each DSITMS analysis will require approximately 3 minutes to execute. Approximately 50 to 60 site samples can be analyzed during a typical field day.

5.2.1 Analysis of Sorbent Traps

Initial calibration of the DSITMS for the analysis of sorbent traps will consist of analysis of calibration standards at seven concentrations (ranging from 0 to 1000 nanograms [ng] on the sorbent trap) for each VOC contaminant of concern for the site. The calibration range for the sorbent trap analysis will initially be set to cover the expected range of MIP vapor concentrations and the site-specific lower action level. The calibration range may be modified based on results obtained during the project. After the DSITMS has been calibrated and passed the performance evaluation check (PEC) sample, sorbent trap samples can be analyzed. Sorbent traps provided by the MIP operator will be analyzed using the DSITMS thermal desorption interface (TDI) (see SOP for sorbent trap DSITMS analysis in Appendix C). Traps will be thermally desorbed by placing them in the TDI which is heated while the carrier gas is allowed to flow through the trap. The concentration of each VOC compound in the MIP vapor will be reported in parts per billion vapor (ppbV) based on the mass of contaminant detected and the volume of MIP vapor that flowed through the Tenax® tube for the collection of the sorbent trap (see Section 3). The detection limits for VOC contaminants of concern in sorbent trap samples using the DSITMS are dependent upon the matrix, but are typically on the order of 100 ppbv.

Periodic QC samples (i.e., blanks, continuing calibration checks (CCCs), and PECs) will be analyzed on a continuing basis. The analytical procedures are described in detail in the sorbent trap DSITMS analysis SOP (see Appendix C). (Note: Tenax® tubes used for the collection of sorbent trap samples will be reused; therefore, each sorbent trap sample will be run through the DSITMS twice to ensure that the Tenax® tube is clean before reuse.)

5.2.2 Analysis of Soil

Analysis of soil samples by DSITMS will be conducted using the 40-mL vial purge interface (see SOP for soil DSITMS analysis in Appendix C). Initial calibration of the DSITMS for the analysis of soil samples will consist of analysis of aqueous calibration standards at seven concentrations (typically ranging from 0 to 500 µg/L) for each VOC contaminant of concern for the site. After the DSITMS has been calibrated and passed the PEC, soil samples can be analyzed. It should be noted that the calibration procedure for the analysis of soil slurries and methanol extracts is the same procedure used to calibrate for groundwater analysis (Section 5.2.3).

Soil cores collected using direct push methods will be immediately sub-sampled as described in Section 4.1.3.1 to collect discrete soil samples. The soil samples will be placed into 40-mL VOA vials containing distilled water for low-level VOC contamination analysis or containing methanol for high-level VOC contamination analysis. To analyze a soil slurry sample, a small amount of the aqueous sample from the 40-mL VOA vial will be decanted and discarded. Soil methanol extract samples will be analyzed by filling a 40-mL VOA vial with distilled water, decanting and discarding a small amount of water from the vial, and injecting 25 to 200 microliters (µL) of the methanol extract into the vial. The sample will then be placed on the 40-mL VOA vial purge interface, and the sample will be analyzed. Soil data will be reported as µg/kg for both low-level and high-level VOC contamination soil analyses. The detection limits for VOC contaminants of concern in soil samples using the DSITMS are on the order of 10 to 20 µg/kg.

CCCs, PECs, and blanks will be analyzed routinely, and frequently, as part of the method. The analytical procedures are described in detail in the soil DSITMS analysis SOP (see Appendix C).

5.2.3 Analysis of Groundwater

Analysis of groundwater samples by DSITMS will be conducted using the 40-mL vial purge interface (see SOP for groundwater DSITMS analysis in Appendix C). Initial calibration of the DSITMS for the analysis of groundwater will consist of analysis of calibration standards at seven concentrations (typically ranging from 0 to 500 µg/L) for each VOC contaminant of concern for the site. After the DSITMS has been calibrated and passed the PEC, groundwater samples can be analyzed. Groundwater will be analyzed by decanting a small amount of the aqueous sample from the 40-mL VOA vial, placing the vial on the DSITMS, and purging the sample. Groundwater data will be reported as µg/L. The detection limits for VOC contaminants of concern in groundwater samples using the DSITMS are on the order of 1 to 5 µg/L.

CCCs, PECs, and blanks will be analyzed routinely, and frequently, as part of the method. The analytical procedures are described in detail in the groundwater DSITMS analysis SOP (see Appendix C).

5.3 DIRECT SAMPLING ION TRAP MASS SPECTROMETER DATA

Data generated by the DSITMS will be reduced using the Varian 2000 software provided by the DSITMS manufacturer. The results are reported by the software as ng for sorbent traps or as µg/L for soil and groundwater samples. Reduced data generated by the DSITMS software will be entered into a spreadsheet where further reduction will be carried out. The mass data (ng) for the sorbent trap analysis is converted to ppbV as described in Section 5.2.1. The data reported for the groundwater analysis will be entered into the spreadsheet and reported directly, adjusted only for any dilution required. The data reported for the low-level soil analysis will be adjusted for dilution based on the mass of soil collected and the amount of water in the extract (see SOP for soil DSITMS analysis in Appendix C). The data reported for the high-level soil analysis will be adjusted for dilution based on the mass of soil collected and the amount of methanol in the extract (see SOP for soil DSITMS analysis in Appendix C).

VOC results from the DSITMS will be recorded in bound logbooks and summarized daily in a spreadsheet. The VOC results spreadsheet containing the data for each day of field work will be provided to the FOL at the beginning of the next field day, and will be forwarded to Columbia’s main office via E-mail for uploading in the data management system for posting on the secure web-page (see Section 8). The DSITMS calibration data will be recorded and documented in the field notebooks, and these data will be reviewed by the FST each field day. QC sample data will be reviewed by the DSITMS analyst as the data are collected. Since the DSITMS analysis is very rapid, any QA problems encountered will be corrected in near real time as they occur. Any QA problems encountered will be noted in the field DSITMS logbook, brought to the immediate attention of the FOL, and annotated in the daily data summary spreadsheet.

Final data reduction will include a summary of all QA data as well as the field sample data. These data will be provided by Tri-Corders to Shaw after the conclusion of the project. The data will be provided as daily summaries in spreadsheets and will include the field sample data and all QA data collected for each day.

6.0 OFF-SITE SAMPLE HANDLING

Samples for off-site laboratory analysis will possibly include PDB groundwater samples, temporary monitoring well groundwater samples, soil samples, and associated QC samples (see Sections 2.3, 4.1.4, and 4.2.5). This section provides details regarding sample labels; COC forms; the field logbook and Daily QC Report; and sample containers, packing, and shipment for samples being sent to the off-site laboratory.

6.1 SAMPLE LABELS

Each off-site field and QC sample will have a sample label uniquely identifying the sampling point, sampling time, and analysis parameters. As each sample is collected, a sample label will be completed with the following information:

a. Project name;

b. Project number;

c. Location/Site Identification – enter the temporary or permanent monitoring well number or grid location, and other pertinent information (e.g., depth) concerning where the sample was collected;

d. Field sample number (see Sections 2.2, 4.1.3.3, and 4.2.4);

e. Date of sample collection;

f. Time of sample collection;

g. Analysis to be performed;

h. Preservatives;

i. The number of containers (i.e., 1 of 2, 2 of 2); and

j. Initials of collector.

The label information will be double-checked by Shaw's senior hydrogeologist to ensure that it is correct. The completed label will be affixed to the sample container. The label will be covered with clear tape, completely encircling the container.

6.2 CHAIN-OF-CUSTODY FORMS

A COC form consisting of at least three copies will be used to track the custody of the off-site samples from the collection point to the off-site analytical laboratory. The COC form will include the following information:

a. Site name, project name, and project number;

b. Field sample number (see Sections 2.2, 4.1.3.3, and 4.2.4);

c. Date of sample collection (for each individual sample);

d. Time of sample collection (for each individual sample, in military time);

e. Indication whether sample is a grab or composite sample (for each individual sample);

f. Total number of containers per sample (for each requested analysis);

g. The analyses requested for each sample container, including size and type of container;

h. The type of preservative, if any, in each container;

i. Name of analytical laboratory;

j. Name of carrier service and airbill number used for tracking purposes;

k. Name and signature of sample team leader;

l. Name and telephone number of Shaw point of contact; and

m. Date and time samples were relinquished, signature of person who relinquished samples, and, if possible, signature of person accepting samples (not necessary if relinquished to national carrier service).

Upon completing the COC form, the “shipper” copy will be retained and the other copies will be placed inside a zip seal plastic bag, inside the sample cooler.

6.3 FIELD LOGBOOK AND DAILY QC REPORT

Information pertinent to the FDVCO investigation sampling efforts will be recorded in a bound logbook as each activity occurs. All boring/sampling procedures and observations will be recorded directly onto an original boring log without transcribing from a field logbook. The field logbook will contain any administrative occurrences, conditions, or activities that may affect the field work or data quality of any environmental samples or field QC samples on any given day or during a given field task.

The front of the logbook will list the project number and facility name; the names of the companies performing activities under the field investigation (e.g., drilling, on-site DSITMS analysis); the service client; the contract under which the investigation is being conducted; and the dates and duration of the field activities. Each page will be consecutively numbered, dated, and signed. All entries will be made in indelible ink, and all corrections will consist of single line-out deletions that are initialed and dated. If only part of a page is used, the remainder of the page should have an “X” drawn across it. Entries in the logbook will include (as applicable), but not be limited to, the following:

a. Project number;

b. Unique field sample number (see Sections 2.2, 4.1.3.3, and 4.2.4);

c. Location and description of each sampling point;

d. Details of the sample site (e.g., the elevation of the casing, casing diameter and depth, integrity of the casing);

e. Name of the field contact;

f. Documentation of procedures for preparation of reagents or supplies which become an integral part of the sample (e.g., filters or absorbing reagents);

g. Identification of sample crew members;

h. Type of sample (e.g., soil, groundwater);

i. Number and volume of sample taken;

j. Requested analyses;

k. Sampling methodology, including distinction between grab and composite samples;

l. Sample preservation;

m. Date and time (military) of sample collection;

n. Associated QA/QC samples;

o. Sample shipment (e.g., name of the laboratory and carrier agent: Federal Express, United Parcel Service, etc.);

p. Field observations (e.g., oily sheen on groundwater sample, incidental odors);

q. Any field measurements (e.g., pH, specific conductance, depth to water, PID readings); and

r. Signature and date by the personnel responsible for observations.

Because sampling situations vary widely, no general rules can specify the extent of information that must be entered in a logbook. However, records should contain sufficient information so that someone can reconstruct the sampling activity without relying on the collector’s memory.

In addition to the field logbook, a summary of each day’s field activities will be documented in a Daily QC Report. This report will summarize the personnel and visitors on site, the equipment on site, the work performed during the day and work proposed for the next day, significant findings and field decisions, and safety issues. The Sample Collection Log Sheet and the Decision Log Sheet will be attached to the Daily QC Report. A Daily QC Report template is provided in Appendix D.

6.4 SAMPLE CONTAINERS, PACKING, AND SHIPMENT

Preservatives will be used, as applicable, to retard hydrolysis of chemical compounds and complexes, to reduce volatility of constituents, and to retard biological action during transit and storage prior to laboratory analysis. Sample holding time is defined as the interval between sample collection to sample extraction and analysis such that a sample may be considered valid and representative of the sample matrix. Sample containers, preservatives, and holding time requirements for samples collected for off-site TCL VOC analysis are as follows:

Soil Samples

Sample Container: Three 5-gram En Core® samplers, filled with zero headspace

Preservation Requirements: Cool to 4 ± 2°C

Holding Time: Preparation (i.e., transfer to the soil sample vials): 48 hours

Analysis: 14 days

Groundwater Samples

Sample Container: Three 40-mL glass vials with Teflon® septum, filled with zero headspace

Preservation Requirements: Cool to 4 ± 2°C, HCl to pH < 2

Holding Time: Analysis: 14 days (7 days if HCl preservation is not used)

Proper sample packing will be essential for the safe delivery of unbroken sample containers to the off-site laboratory that provide reliable environmental data. Prior to shipment of PDB and temporary monitoring well groundwater samples, and associated field QC samples (i.e., duplicates and/or trip blanks) for off-site laboratory analysis, the following procedures will be performed on each sample container:

a. The cap tightness will be checked and it will be verified that clear tape covers the label and completely encircles the container;

b. Each sample container will be wrapped in bubble wrap or closed cell foam sheets; and

c. Each sample container will be enclosed in a clear, zip seal, plastic bag.

Prior to shipment of soil samples, and associated field QC samples (i.e., co-located soil samples), for off-site laboratory analysis, the following procedures will be performed on each sample container:

a. The cap tightness of each En Core® sampler will be checked;

b. All three En Core® samplers (making up one sample) will each be placed in a small foil envelope which will be sealed and affixed with a sample label; and

c. The three sample envelopes will be enclosed in a clear, zip seal, plastic bag.

Once the above procedures are completed for each sample container, the following procedures will be performed for each sample cooler:

a. Several layers of bubble wrap, or at least one inch of vermiculite, will be placed on the bottom of the cooler. The cooler will be lined with an open garbage bag, all samples will be placed upright inside the garbage bag, and the bag will be tied. A temperature blank will be placed in each cooler to monitor internal temperature.

b. Loose ice will be double-bagged and sealed to prevent melting ice from soaking the packing material. The ice will be placed outside the garbage bag containing the samples.

c. Appropriate sample documentation (i.e., COC forms) will be placed in a waterproof plastic bag (zip seal bag), and the bag will be taped to the underside of the cooler lid. If more than one cooler is being used, each cooler will have its own documentation.

d. Each cooler will be sealed with signed and dated custody seals so that if the cooler is opened, the custody seal will be broken. Clear tape will be placed over the custody seal to prevent damage to the seal.

e. Each cooler will be taped shut with packing tape over the hinges, and tape will be placed over the cooler drain (if the cooler has a drain plug).

Every effort will be made to ship samples to the off-site laboratory on the day of collection or as soon after the day of collection as possible. Separate COC forms will be prepared for each day of sample collection so that sample holding times can be more readily tracked.

7.0 OFF-SITE LABORATORY ANALYSIS

Soil and groundwater samples shipped off site for laboratory analysis will be analyzed by Accutest Laboratories, Inc. (Accutest) located in Orlando, Florida, for TCL VOCs. Accutest is a Missouri River Division (MRD) validated laboratory. All sample analyses will be performed following the method requirements and project-specific data quality indicator (DQI) requirements as noted in Appendix E**.** The cited criteria have been adapted from the USEPA SW-846 methodology requirements (USEPA, 1996b) and the USACE Shell for Analytical Chemistry Requirements (USACE, 2001).

7.1 LABORATORY ANALYSIS AND DATA REPORTING

Samples will be analyzed by Accutest for TCL VOCs using USEPA SW-846 5035/8260B for solid samples and USEPA SW-846 Method 5030B/8260B for aqueous samples using purge and trap technology. Laboratory SOPs for the extraction and analytical methods to be used for the analysis of off-site soil and groundwater samples may be found in Appendix E. For solid samples, an inert gas is bubbled through a mixture of reagent water and 5 grams of the soil sample contained in a specifically designed purging chamber at 40ºC. For aqueous samples, an inert gas is bubbled through a 25-mL groundwater sample contained in a specifically designed purging chamber at ambient temperature. The resulting vapor is swept through a sorbent column where the purgeable compounds are trapped. After purging is completed for both solid and aqueous samples, the sorbent column is heated and backflushed with the inert gas to desorb the purgeable compounds onto a gas chromatograph programmed to separate the purgeable compounds, which are then detected with a mass spectrometer.

As part of the FDVCO investigation, Accutest will provide the analytical results for both laboratory and field QC samples, method blank results, matrix spike/matrix spike duplicate (MS/MSD) results, laboratory control sample (LCS) results, and initial and continuing calibration results. The laboratory will also provide full Contract Laboratory Program (CLP)-equivalent data packages including all the QC results and raw data necessary for data validation in accordance with the USEPA Region 3 Modifications to the National Functional Guidelines (NFGs) (USEPA, 1994).

Laboratory QC data will be reported separately from the environmental data, but will be grouped by analysis method. Data necessary for calculation of percent recoveries will be presented along with the analytical results. The section containing QC data will also include upper and lower control limits for percent recovery. The following information is required for complete evaluation of the analytical data:

- Laboratory sample identification number;
- Shaw field sample number;
- Sample media and depth;
- Sample collection and laboratory receipt dates;
- Sample Delivery Group (SDG) identification numbers;
- Extraction and analytical method numbers used;
- Sample extraction and analysis dates;
- Volume or mass of sample purged or extracted;
- Percent moisture for each solid sample;
- Upper and lower control limits of percent recovery and relative percent difference (RPD) calculations for all applicable QC check analyses; and
- Parameter analyzed, analytical result, units, and detection level for each compound analyzed.

7.2 QUALITY ASSURANCE/QUALITY CONTROL

QA is defined as the overall system for assuring the reliability of data generated in support of the FDVCO investigation. The system provides independent verification that the established QC measures are implemented by project participants in a manner that ensures the integrity of the environmental sampling and analysis activities. This section presents the QA/QC program for the off-site PDB groundwater samples and the off-site soil and temporary monitoring well groundwater samples collected at AREE 34 as part of the FDVCO investigation. This QA/QC program will include the review of all analytical data produced by the off-site analytical laboratory (i.e., Accutest).

Prior to sample analysis, chemical calibration of each target compound must be performed to ensure that the analytical instrumentation is functioning within the established sensitivity range. Laboratory calibration steps include the performance of solution validation, initial calibration, daily calibration, and continuing calibration procedures. Protocols defining the QC procedures, rounding rules, corrective actions, and QC measurements for instrument calibration should be in accordance with criteria specified in the analytical method, laboratory QA plan, and laboratory SOPs. The method detection limits (MDLs) and the reporting limits (RLs) for the analytical methods to be used are found in Appendix E**.**

7.2.1 Precision

Sampling precision will be evaluated by calculating and evaluating the RPD between the results of field duplicates, and laboratory precision will be evaluated using laboratory sample or spiked sample duplicates. RPD will be calculated only for those analytes that are detected at levels exceeding the RLs in both samples of the duplicate pair. Analytes in samples that are non-detect or qualified as non-detect because of blank contamination will be excluded.

For temporary monitoring well groundwater sample analytical results, sampling precision will be evaluated by collecting and analyzing one duplicate sample for every 10 primary samples sent to the off-site laboratory (10% frequency) (see Section 4.2.5). Duplicate samples will be analyzed for the same parameters as the primary samples (i.e., TCL VOCs). Precision will be evaluated by calculating the RPD as follows:

$$\text{RPD (\%)} = (/X_A - X_B/ \div X_M) \times 100$$

where:

X_A and X_B are the concentrations in the primary sample and its duplicate; and

X_M is the mean value of the concentrations in the primary sample and its duplicate, $(X_A + X_B)/2$.

Field precision control criteria will be established at 50% RPD for groundwater samples. Since co-located soil samples will be collected instead of duplicate samples for reasons explained in Section 4.1.4, analysis of sampling precision is not applicable to soil samples.

The laboratory precision criteria may be found in Appendix E**.**

Analytical results will be qualified as estimated (J) during the validation process for RPDs exceeding criteria.

7.2.2 Accuracy

Sampling accuracy will be assessed by evaluating blank contamination and determining the impact of contaminant contributions originating from non-point sources, such as field sampling equipment decontamination procedures, or laboratory contamination. QC samples evaluated for this assessment will include trip blanks (for aqueous samples) and laboratory method blanks. Equipment blanks associated with off-site samples will not be collected during the FDVCO investigation because disposable sampling equipment that does not require field decontamination will be utilized (see Sections 2.3, 4.1.4, and 4.2.5).

Spiked laboratory samples including LCSs and MS/MSDs are also to be evaluated in terms of percent recovery, in conjunction with other QC information, during the data validation process to ascertain the acceptability of the data generated for that batch of samples.

7.2.3 Representativeness

Documents that will be reviewed to infer sample representativeness will include analytical records (holding times), blank contamination assessment (secondary inference), and associated project records. This review will assess whether the designed sampling program resulted in the collection of representative samples.

7.2.4 Completeness

Completeness goals for off-site soil and groundwater samples collected as part of the AREE 34 FDVCO investigation have been established at 90%. Completeness will be inferred from records review and data validation. Sampling completeness will not be assessed since the number of off-site soil and groundwater samples to be collected has not been pre-established.

Analytical completeness will be assessed by comparing the number of usable data points collected to the total number of data points generated. Unusable data are defined to include rejected data points (“R” qualifier) or those data points which have been considered as “non-detects” due to blank contamination (“B” qualifier).

7.2.5 Sensitivity

Accutest’s MDLs and RLs for TCL VOC analysis of solid and aqueous samples by the analytical methods specified in Section 7.1 are listed in Appendix E**.** The MDL is the minimum concentration of a compound that can be measured and reported with a 99% confidence that the compound is above zero, and is determined from analysis of a sample in a given matrix containing the compound. The MDLs are derived by the method based upon 40 CFR Chapter 136, Appendix B. The laboratory will use a RL to represent the level of sensitivity for each sample. The RL should be 3 times the MDL, but must be at least 2 times the MDL. The RL is the threshold value below which the laboratory reports any non-detected value as “U”, “ND”, or “<” and will vary for each sample based upon dilution, sample volumes, percent moistures (for solids), and the method performed. The method quantitation limit (MQL) is the value at which the laboratory has demonstrated the ability to reliably quantitate the target value of a compound for the method performed. USACE defines the MQL based upon the lowest calibration standard or the lowest verification standard used for the initial calibration performed. The MQL should be 5 times the MDL, but must be at least 3 times the MDL. Any positive value found above the MDL for a given sample and below the RL or 3 times the MDL (whichever is greater) must be reported as estimated “J”. In addition, all positive values found in blanks (method, trip) above the MDL must be reported.

7.2.6 Data Review and Validation

Groundwater and soil sample QC forms provided by the off-site laboratory will be reviewed and evaluated for compliance with the DQIs presented in Appendix E. The analytical results will be qualified as necessary based on any non-conformities identified during the data review.

In addition, 100% of the analytical results for the soil samples analyzed by the off-site laboratory, which may be used for risk assessment purposes, will be independently validated in accordance with USEPA Region 3 Modifications to the NFGs (USEPA, 1994) to ensure compliance with specified analytical and QA/QC requirements; data reduction procedures; data reporting requirements; and required precision, accuracy, and completeness criteria (see Sections 7.2.1, 7.2.2, and 7.2.4). The following items will be reviewed to validate the data:

- Sample holding times;
- Documentation that the analytical results are in control and within the certified range;
- Documentation that data and calculations were checked by a reviewer who was not involved in the performance of sampling, analysis, or data reduction;
- Calibration of methods and instruments (initial and continuing);
- Routine instrument performance checks (calibration, LCSs, etc.);
- Documentation on traceability of instrument standards, samples, and data;
- Documentation on analytical methodology and QC methodology;
- The potential presence of interferences in analytical methods (check of reference blanks and spike recoveries [surrogate and MS/MSD]);
- Documentation of routine maintenance activity to ensure analytical reliability;
- Documentation of sample preservation and transport; and

- Raw instrument printouts (e.g., chromatograms, strip charts, etc.) for quantitation verification.

Appropriate data qualifiers resulting from the data validation will be added to the results.

8.0 DATA MANAGEMENT AND COMMUNICATIONS

A critical component of the USEPA Triad approach used in conducting this FDVCO investigation is the management of the data collected in the field and the communication of that data to the FST and the WG. Management of the data is not restricted to only data generated during the field program, but historical data as well. Historical data is necessary for comparison of the real-time data that will be generated during this FDVCO investigation.

8.1 DATA MANAGEMENT

The management of the data generated during the FDVCO investigation, as well as the historical data, will be handled by a software processing package called SmartData Solutions™ which will allow: 1) the input of field data on a daily basis; and 2) the WG to review the data as three-dimensional images which will be posted on a secure project web-page. Columbia will upload data into and will maintain the data management system following the procedures provided in the associated SOP (see Appendix F).

8.1.1 Historical and Background Data

Prior to the initiation of the FDVCO investigation, the following historical and background data will be placed into the software:

a. Groundwater elevation data from relevant past synoptic water level measurements;

b. Groundwater quality data from previous sampling events of the permanent saturated overburden and bedrock aquifer monitoring wells;

c. Groundwater quality data from the previous temporary monitoring well sampling event;

d. Soil analytical data from the previous subsurface soil sampling event;

e. Figures from the AREE 34 RI and SRI that graphically present sample locations, hydrogeologic data, and water quality results;

f. The horizontal surveyed (or grid-based) locations (based on latitude and longitude) of the permanent groundwater monitoring wells, the previous temporary monitoring wells, and the previous soil borings; and

g. The surveyed elevations (ft amsl) of the permanent groundwater monitoring wells and the previous temporary monitoring wells (to the extent available).

As discussed in Section 3, any of the above sampling points that have not been previously surveyed will be located with a GPS unit (to the extent possible). Before the initiation of the FDVCO investigation field activities, the historical and background data will be posted to the secure project web-page. This will allow the FST and the WG to confirm that they are able to access the data on the web-page.

8.1.2 FDVCO Investigation Data

The following information generated during the FDVCO investigation will be placed into the software as the field activities are conducted and the data becomes available:

a. PDB groundwater sample on-site DSITMS analysis results;

b. PDB groundwater sample off-site analysis results (when they become available);

c. MIP data;

d. Sorbent trap/on-site DSITMS analysis results;

e. Any collaborative soil sample on-site DSITMS analysis results;

f. Any collaborative soil sample off-site analysis results (when they become available);

g. Any collaborative temporary monitoring well groundwater sample on-site DSITMS analysis results; and

h. Any collaborative temporary monitoring well groundwater sample off-site analysis results (when they become available).

8.1.3 Data Input and Availability

As discussed in Section 8.1.1, the historical and background data will be placed into the data management software prior to the initiation of the FDVCO investigation field activities. The data generated during the FDVCO investigation will be E-mailed twice a day (approximately at midday and at the end of the day) to Columbia's main office where the data will be normalized, processed, and posted on the secure project web-page. As mentioned above, the web-page will be available for access prior to the start of the FDVCO investigation field activities. All members of the FST, and any appropriate other interested parties, will be given the web-page address and a password that will grant them access. In addition to the data generated by the FDVCO investigation field activities, this FDVCO-WP, Daily QC Reports (see Section 6.3), and a map showing sample/probe locations will be posted on the web-page.

8.2 DATA COMMUNICATIONS

The primary focus of communication between the FST and the WG will be the secure project web-page. Direct communication with the FST by members of the WG will be channeled through the FOL. A conference call with the key members of the FST and the WG will be held at 17:00 (Eastern Standard Time [EST]) on the second day of field activities. The conference call will allow the FST to update the WG on the progress of the FDVCO) investigation and to review the PDB groundwater sample results as well as the initial MIP and sorbent trap results. A second conference call will be scheduled for 12:00 EST on the fourth day of field activities to review the ongoing progress of the FDVCO investigation. During this second conference call, the FST will present its recommendations regarding the need for and, if needed, the number, location, and depth of additional collaborative soil or temporary monitoring well groundwater samples to complete the FDVCO investigation. If the FST determines there is a significant change in field conditions or anticipated results, they may elect to have an unscheduled conference call with the WG.

9.0 DECONTAMINATION

In this section, construction of the decontamination (decon) pad and the decontamination water source are discussed as well as the decontamination procedures.

9.1 DECONTAMINATION PAD CONSTRUCTION

Columbia will construct a temporary, portable decon pad prior to the start of the high density sampling field work. The decon pad will be lined with two layers of polyethylene sheeting, and sloped to allow for the containment of decon water. The sides will be constructed of two layers of polyethylene sheeting supported by plywood walls (or equivalent). A centrifugal pump will be used to pump the accumulated decon water from the pad into 55-gallon drums located near the decon pad.

The decon pad will be used to contain the water from decontamination of the Geoprobe® drill rig, downhole equipment, and all sampling equipment. The Geoprobe® drill rig will be backed into the decon pad and cleaned using the procedures outlined in Section 9.2. Downhole drilling equipment, Macrocore samplers, and well casing/screen will be placed on metal sawhorses (or equivalent) inside the decon pad for decontamination. Non-disposable sampling equipment (e.g., syringes for collection of soil samples for on-site DSITMS analysis) will be decontaminated in plastic tubs placed on plastic sheeting.

9.2 DECONTAMINATION OF GEOPROBE® DRILL RIG AND DOWNHOLE EQUIPMENT

Prior to beginning drilling operations, and at the end of the field work, the Geoprobe® drill rig and downhole equipment will be steam-cleaned with USACE-approved water (unchlorinated water from Production Well No. 3). This activity will be performed in the leak-proof decontamination pad that will be constructed prior to commencement of the field work. The decontamination process is briefly outlined below.

a. Steam clean using USACE-approved water; and

b. Air dry.

9.3 DECONTAMINATION OF GEOPROBE® MACROCORE SAMPLERS

Between drilling locations, the Geoprobe® Macrocore samplers will be decontaminated. This activity will be performed in the leak-proof decontamination pad that will be constructed prior to commencement of the field work. The decontamination process is briefly outlined below.

a. Wash and scrub with non-phosphate detergent;

b. Rinse with USACE-approved water;

c. Rinse with deionized, organic-free water; and

d. Wrap in plastic sheeting (or place in a clean, secure area) to prevent contamination during storage/transit.

9.4 DECONTAMINATION OF TEMPORARY MONITORING WELL CASING AND SCREEN

Prior to use, temporary monitoring well casing and screen materials will be decontaminated. This activity will be performed in the leak-proof decontamination pad that will be constructed prior to commencement of the field work. The decontamination process is briefly outlined below.

a. Steam clean using USACE-approved water;

b. Rinse with deionized, organic-free water;

c. Air dry; and

d. Wrap in plastic sheeting (or place in a clean, secure area) to prevent contamination during storage/transit.

If the temporary monitoring well casing and screen materials are delivered to the site in sealed wrappers, a rinse sample will be collected for analysis of VOCs using the on-site DSITMS to determine the need for decontamination prior to use.

9.5 DECONTAMINATION OF SAMPLING EQUIPMENT

The following section presents the decontamination of non-dedicated, non-disposable sampling equipment.

Water Level Indicator

a. Wash with non-phosphate detergent;
b. Rinse with USACE-approved water;
c. Rinse with deionized, organic-free water;
d. Wrap in plastic sheeting to prevent contamination during storage/transit.

Sampling Equipment

a. Wash with non-phosphate detergent, and scrub with a brush to remove any particulate matter and surface film;
b. Rinse with USACE-approved water;
c. Double-rinse with isopropanol;
d. Rinse with deionized, organic-free water;
e. Air dry; and
f. Wrap in plastic sheeting to prevent contamination during storage/transit.

10.0 DISPOSAL OF INVESTIGATION-DERIVED WASTES

This section describes the management of the investigation-derived wastes (IDW) generated during the FDVCO investigation field activities.

10.1 DECONTAMINATION AND PURGE WATER

Decon and purge water will be disposed at the conclusion of the field activities. During the field activities, water will be periodically pumped out of the decon pad into 55-gallon drums located adjacent to the decon pad. Any purge water (e.g., residual water from sampling groundwater from the PDB samplers and temporary monitoring wells) generated from the FDVCO investigation field activities will be poured into one of the 55-gallon drums used to containerize the decon water. The accumulated decon and purge water will be treated through a drum of granular activated carbon (GAC) to remove the VOC contaminants. Once treated, the water will be discharged to the sanitary sewer system.

10.2 PERSONAL PROTECTIVE EQUIPMENT/DISPOSABLE EQUIPMENT/OTHER SOLID WASTE

All used PPE, acetate liners, disposable bailers, temporary monitoring well materials, and plastic sheeting used in construction of the decon pad will be containerized in 55-gallon drums and disposed of with the soil cuttings (see Section 10.3).

10.3 SOIL CUTTINGS DERIVED FROM DRILLING ACTIVITIES

All soil cuttings generated as a result of drilling activities associated with the FDVCO investigation will be drummed, labeled, and transported to the former AAFES Service Station to await off-site disposal based on waste characterization data to be collected as part of a subsequent field investigation at AREE 34.

11.0 FDVCO INVESTIGATION PROPOSED SCHEDULE

This table below presents the proposed schedule for the FDVCO investigation field activities.

DATE	ACTIVITY
Friday, October 24, 2003	Layout remainder of grid system.
Monday, October 27, 2003	Install PDB samplers into selected wells.
Monday, November 3, 2003	Initiate subsurface utility clearance.
Thursday, November 6, 2003	Secured project web-page is available.
Monday, November 17, 2003	Initiate high density sampling. Remove PDB samplers and collect groundwater samples. Begin on-site analysis of PDB groundwater samples.
Tuesday, November 18, 2003 (10:00 EST)	Site visit opportunity for USACE and USEPA
Tuesday, November 18, 2003 (17:00 EST)	Conference call with FST and WG.
Wednesday, November 19, 2003 (10:00 EST)	Site visit opportunity for USACE and USEPA
Thursday, November, 20, 2003 (12:00 EST)	Conference call with FST and WG. FDVCO investigation continues as agreed upon by the WG.
Friday, November 21, 2003	Anticipate completion of FDVCO investigation field activities.
Wednesday, December 23, 2003	Submittal of Summary Report including recommendations regarding the need for and placement of additional permanent saturated overburden monitoring wells.

12.0 REFERENCES

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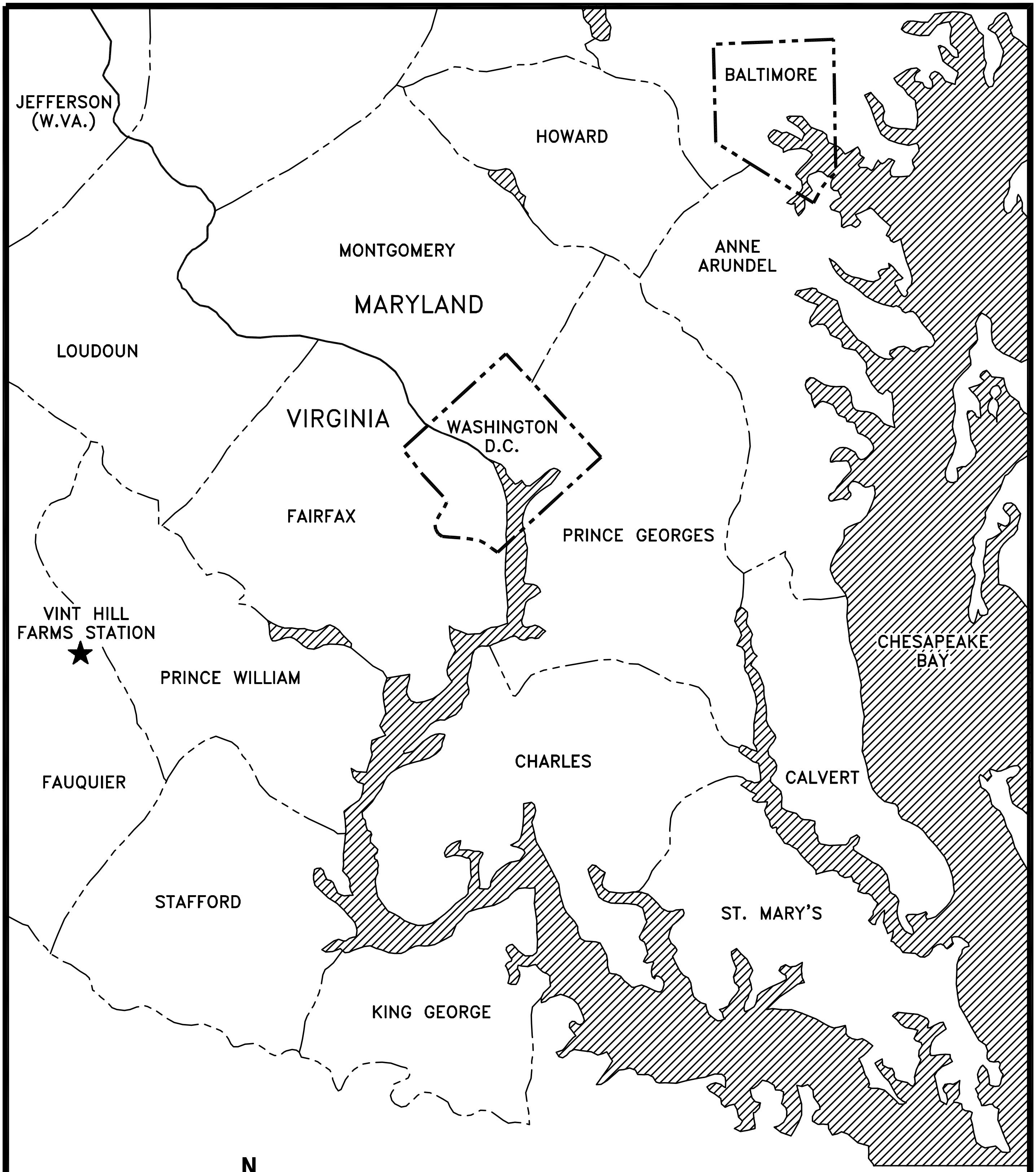

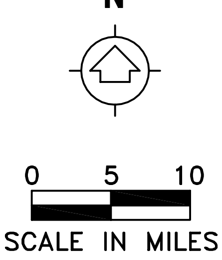

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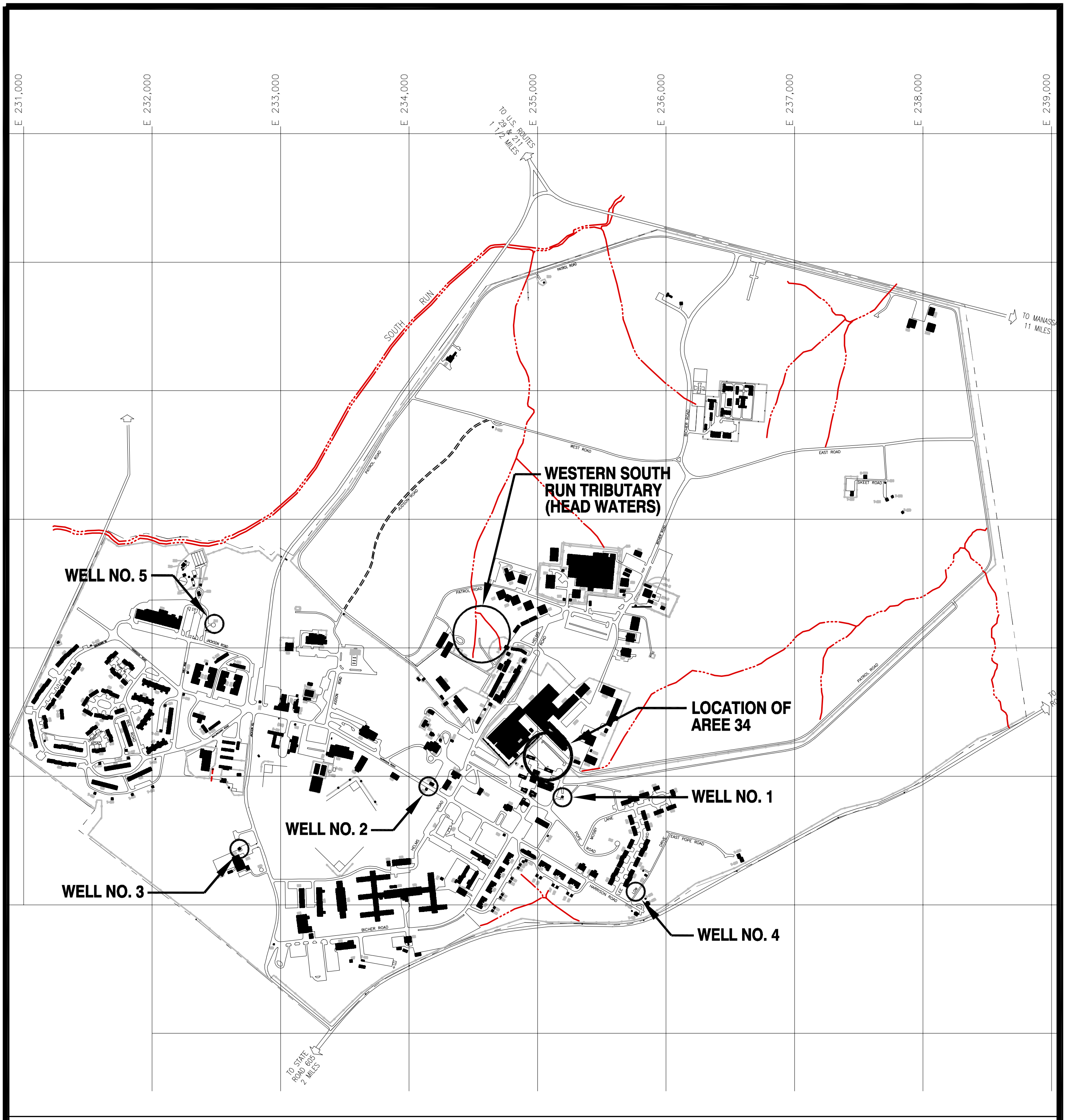
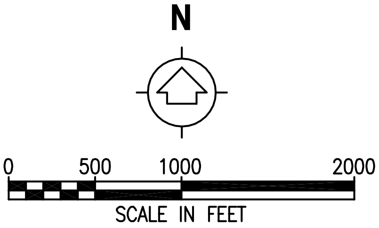
BALTIMORE DISTRICT

CONTRACT NO. DACA31-01-F-0142	FIGURE 1-1 VINT HILL FARMS STATION
Shaw™ Shaw Environmental, Inc.	GENERAL LOCATION OF VHFS
PREPARED WSS	TASK NO: 84507908000000
CHECKED NZ	SHAW DWG NO:
DATE 9-16-03	GSA1-080-02-001





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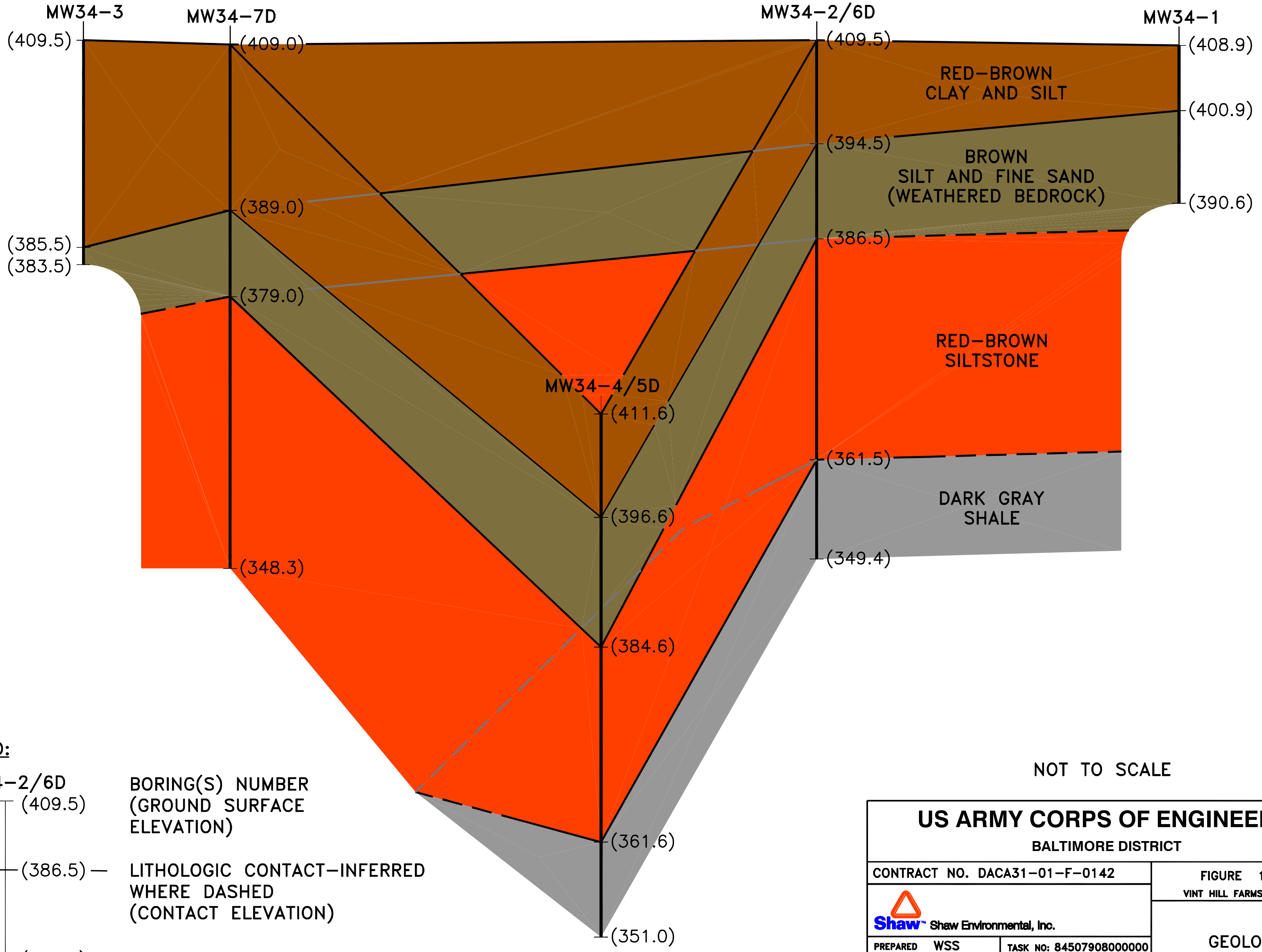
CONTRACT NO. DACA31-01-F-0142

FIGURE 1-2
VINT HILL FARMS STATION

Shaw™ Shaw Environmental, Inc.

PREPARED	WSS	TASK NO:	84507908000000
CHECKED	NZ	SHAW DWG NO:	
DATE	9-16-03		GSA1-080-02-002

SITE MAP AND
LOCATION OF
AREE 34



NOT TO SCALE

LEGEND:

MW34-2/6D (409.5)	BORING(S) NUMBER (GROUND SURFACE ELEVATION)
(386.5)	LITHOLOGIC CONTACT-INFERRED WHERE DASHED (CONTACT ELEVATION)
(349.4)	BOTTOM OF HOLE (BOTTOM OF HOLE ELEVATION)

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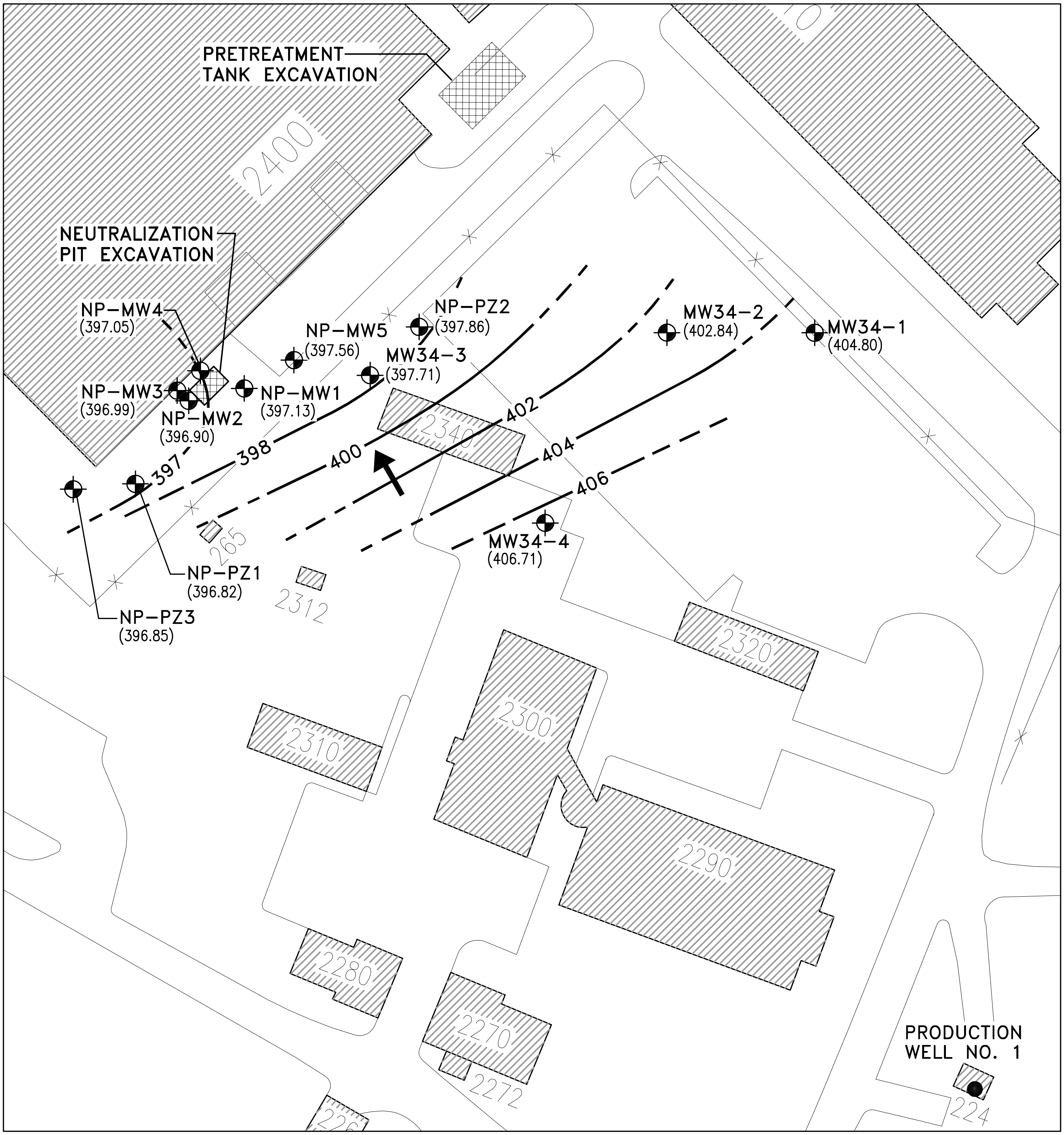
PREPARED	WSS	TASK NO:	84507908000000
CHECKED	CAK	SHAW DWG NO:	GSA1-080-02-003
DATE	9-16-03		

FIGURE 1-3
VINT HILL FARMS STATION

GEOLOGIC FENCE DIAGRAM



LEGEND:

▨ .... BUILDING

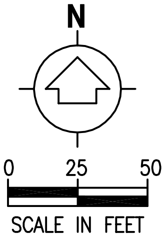
—×—×—×— .... FENCE

MW34-4
(406.71)
⊕ .... OVERBURDEN MONITORING WELL AND GROUNDWATER ELEVATION (FT AMSL)

PRODUCTION
WELL NO. 1
● .... PRODUCTION WELL

—400— .... GROUNDWATER ELEVATION CONTOUR

← .... DIRECTION OF GROUNDWATER FLOW



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PREPARED WSS

CHECKED NZ

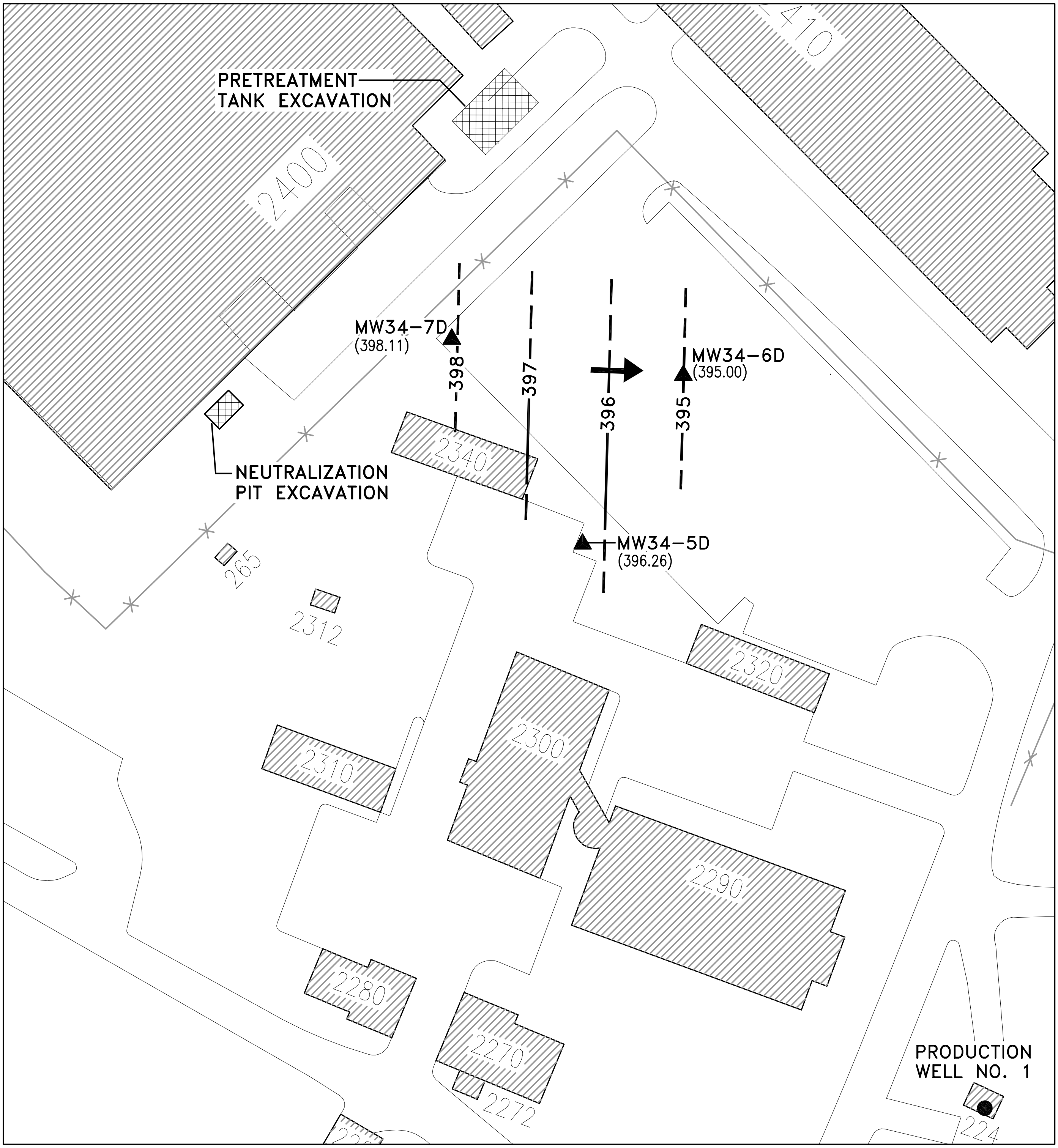
DATE 9-16-03

TASK NO: 84507908000000

SHAW DWG NO: GSA1-080-02-004

FIGURE 1-4
VINT HILL FARMS STATION

JANUARY 13, 2003
WATER TABLE
CONTOUR PLAN



LEGEND:

▨ .... BUILDING

—×—×—× .... FENCE

MW34-7D
▲(398.11) .... BEDROCK MONITORING WELL AND GROUNDWATER ELEVATION (FT AMSL)

PRODUCTION
WELL NO. 1
● .... PRODUCTION WELL

—396— .... GROUNDWATER ELEVATION CONTOUR

← .... DIRECTION OF GROUNDWATER FLOW

N

0 25 50
SCALE IN FEET

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BALTIMORE DISTRICT

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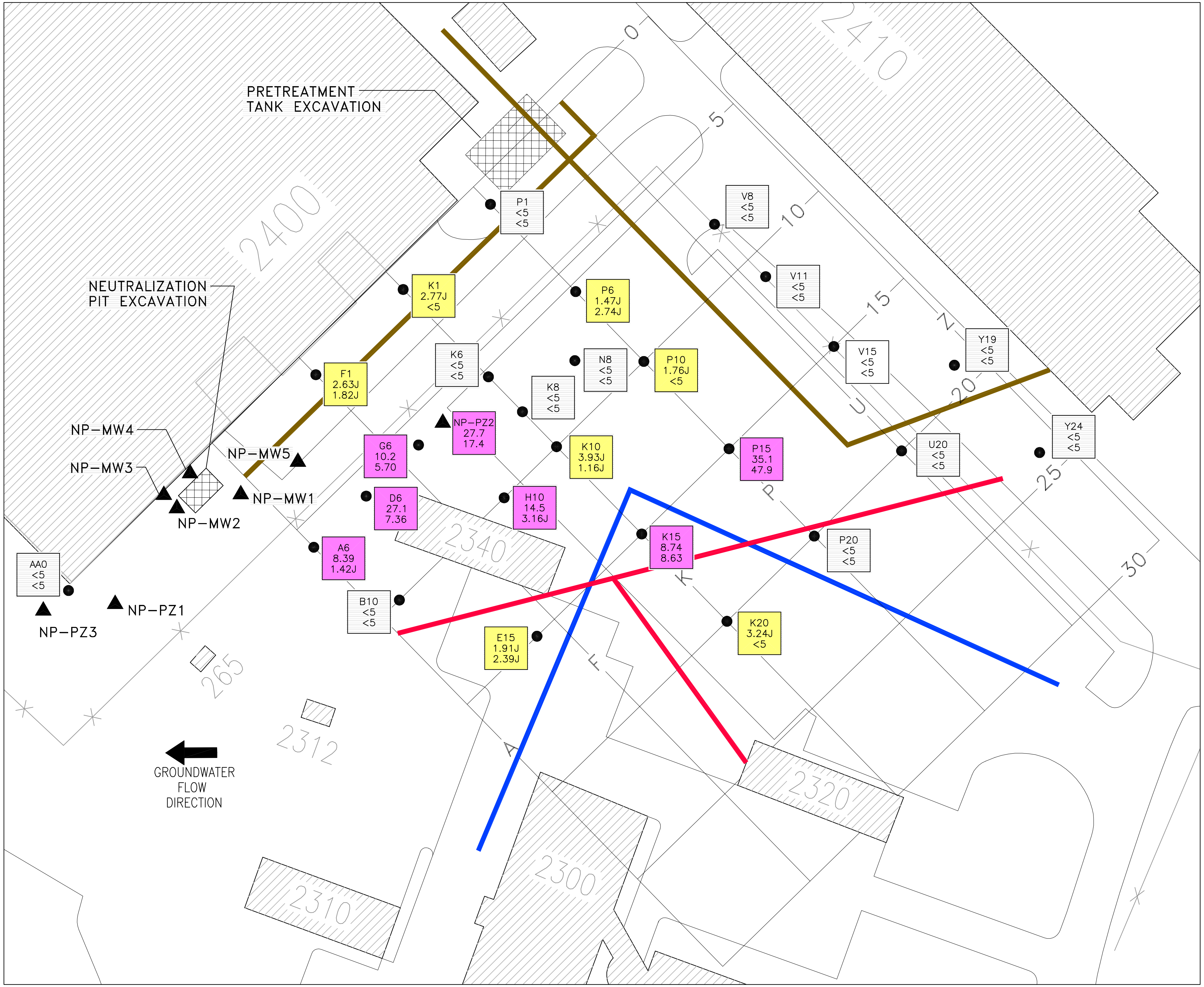
CHECKED NZ
DATE 9-16-03

TASK NO: 84507908000000
SHAW DWG NO:
GSA1-080-02-005

FIGURE 1-5
VINT HILL FARMS STATION

JANUARY 13, 2003
BEDROCK
GROUNDWATER
ELEVATION CONTOUR
PLAN



LEGEND:

▨ ....BUILDING
×—×—× ....FENCE
▲ ....EXISTING MONITORING WELL LOCATION
● ....TEMPORARY WELL LOCATION

D6 — GRID LOCATION IDENTIFICATION
27.1 — TETRACHLOROETHENE CONCENTRATION (μg/L)
7.36 — TRICHLOROETHENE CONCENTRATION (μg/L)

NOTE; DUPLICATE SAMPLES WERE COLLECTED AT GRID LOCATIONS G6, K15, AND P6. THE CONCENTRATIONS PRESENTED ARE THE HIGHER OF THE TWO RESULTS.

☐ BOTH TETRACHLOROETHENE AND TRICHLOROETHENE CONCENTRATIONS BELOW MRL

🟨 EITHER TETRACHLOROETHENE OR TRICHLOROETHENE, OR BOTH, DETECTED BELOW MRL, BUT ABOVE MDL

🟪 EITHER TETRACHLOROETHENE OR TRICHLOROETHENE, OR BOTH, DETECTED ABOVE FEDERAL MAXIMUM CONTAMINANT LEVEL (BOTH AT 5 μg/L)

🟥 BURIED ELECTRIC LINE

🟦 BURIED WATER LINE

🟫 BURIED SANITARY SEWER LINE

N

0 25 50
SCALE IN FEET

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BALTIMORE DISTRICT

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FIGURE 1-6
VINT HILL FARMS STATION

Shaw Environmental, Inc.

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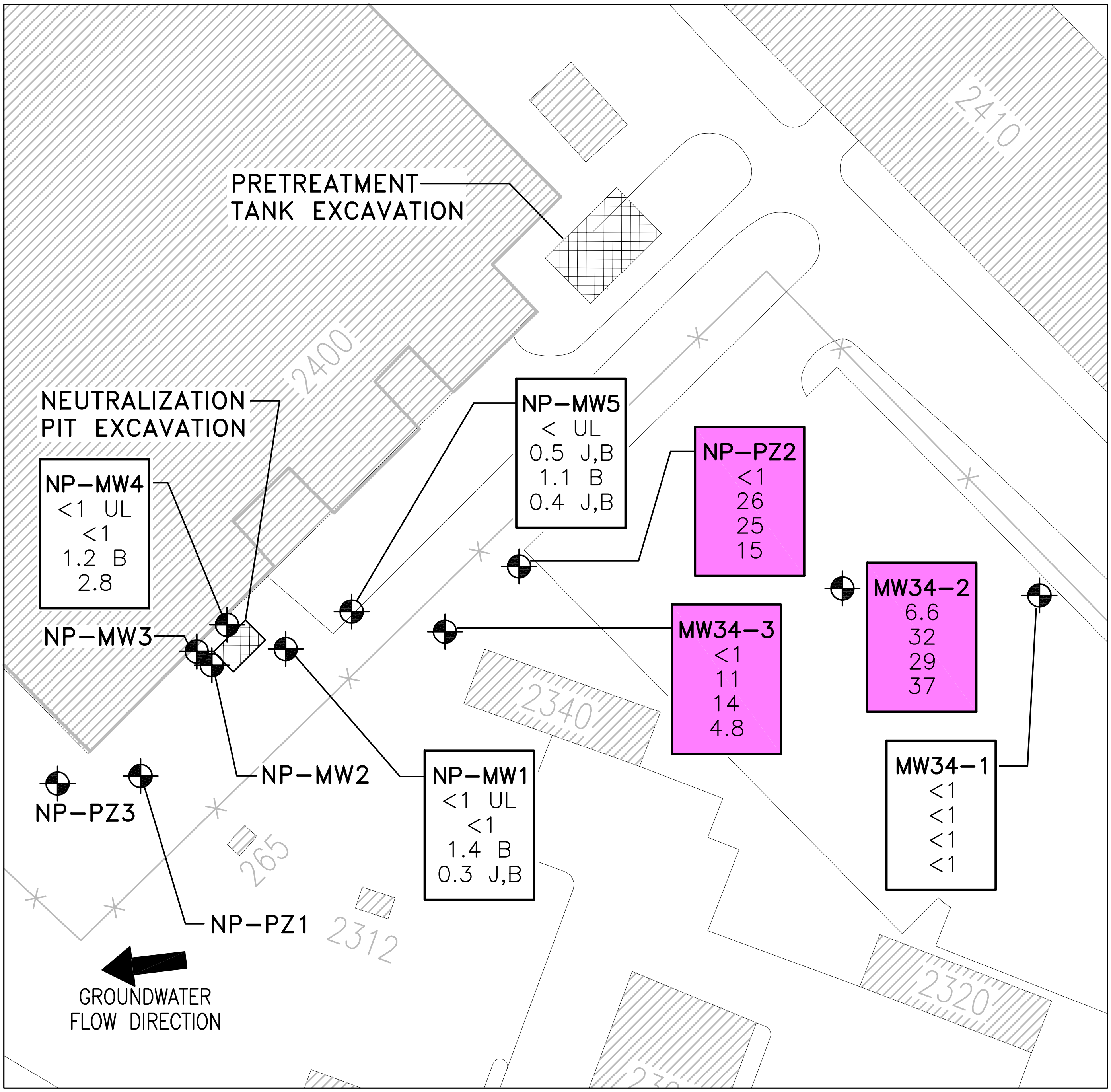
CHECKED NZ
DATE 9-16-03

TASK NO: 84507908000000
SHAW DWG NO:
GSA1-080-02-006

AREE 34 RI
TEMPORARY
WELL RESULTS
(MARCH 2001)



LEGEND:

▨ .... BUILDING

—×—×—×— .... FENCE

⊕ .... MONITORING WELL LOCATION

☐ ALL VOC ANALYTES BELOW FEDERAL MAXIMUM CONTAMINANT LEVEL (MCL)

■ ONE OR MORE VOC ANALYTES DETECTED ABOVE FEDERAL MCL

MW34-2	MONITORING WELL ID
6.6	CARBON TETRACHLORIDE CONCENTRATION (μg/L); MCL = 5 μg/L
32	1,1-DICHLOROETHENE CONCENTRATION (μg/L); MCL = 7 μg/L
29	TETRACHLOROETHENE CONCENTRATION (μg/L); MCL = 5 μg/L
37	TRICHLOROETHENE CONCENTRATION (μg/L); MCL = 5 μg/L

NOTE:

DUPLICATE SAMPLES WERE COLLECTED FROM MW34-2. THE CONCENTRATIONS PRESENTED ARE THE HIGHER OF THE TWO RESULTS.

N

0 25 50

SCALE IN FEET

US ARMY CORPS OF ENGINEERS

BALTIMORE DISTRICT

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Shaw™ Shaw Environmental, Inc.

PREPARED WSS

CHECKED NZ

DATE 9-16-03

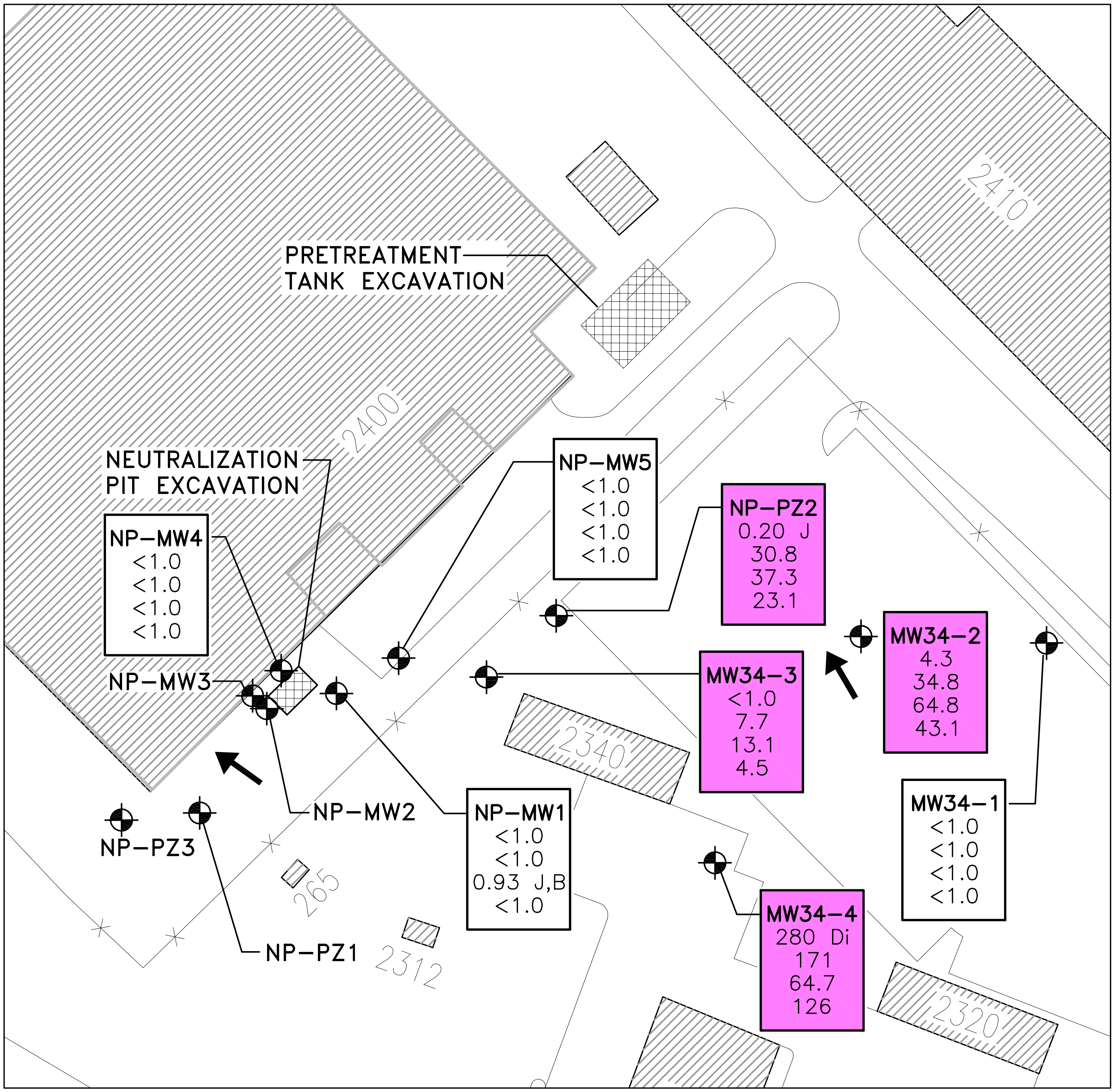
TASK NO: 84507908000000

SHAW DWG NO: GSA1-080-02-007

FIGURE 1-7

VINT HILL FARMS STATION

AREE 34 RI GROUNDWATER ANALYTICAL RESULTS (MAY 2001)



LEGEND:

▨ BUILDING

×—×—× FENCE

⊕ MONITORING WELL LOCATION

← DIRECTION OF GROUNDWATER FLOW

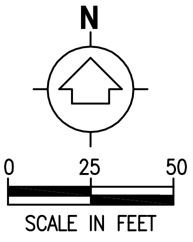
☐ ALL VOC ANALYTES BELOW FEDERAL MAXIMUM CONTAMINANT LEVEL (MCL)

🟪 ONE OR MORE VOC ANALYTES DETECTED ABOVE FEDERAL MCL

MW34-2 — MONITORING WELL ID
4.3 — CARBON TETRACHLORIDE CONCENTRATION (µg/L); MCL = 5 µg/L
34.8 — 1,1-DICHLOROETHENE CONCENTRATION (µg/L); MCL = 7 µg/L
64.8 — TETRACHLOROETHENE CONCENTRATION (µg/L); MCL = 5 µg/L
43.1 — TRICHLOROETHENE CONCENTRATION (µg/L); MCL = 5 µg/L

NOTE:

DUPLICATE SAMPLES WERE COLLECTED FROM MW34-2. THE CONCENTRATIONS PRESENTED ARE THE HIGHER OF THE TWO RESULTS.



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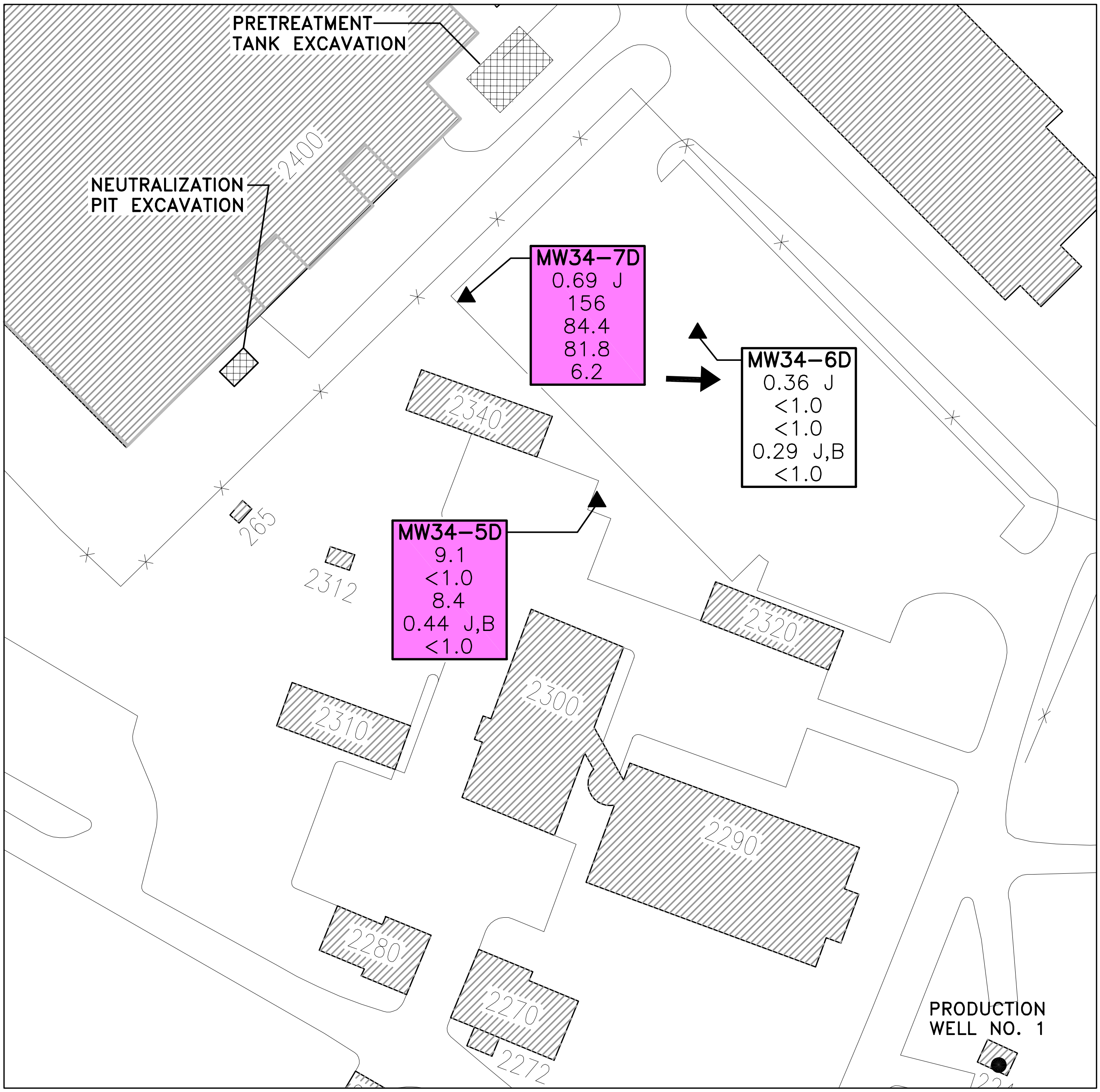
Shaw Environmental, Inc.

PREPARED WSS
CHECKED NZ
DATE 9-16-03

TASK NO: 84507908000000
SHAW DWG NO: GSA1-080-02-008

FIGURE 1-8
VINT HILL FARMS STATION

AREE 34
SRI OVERBURDEN
GROUNDWATER
ANALYTICAL RESULTS
(JANUARY 14, 2003)



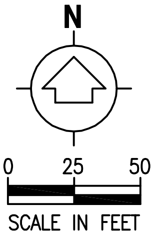
LEGEND:

▨ ....BUILDING
—×—×— ....FENCE
▲ ...BEDROCK MONITORING WELL LOCATION
● ....PRODUCTION WELL
⬅ ....DIRECTION OF GROUNDWATER FLOW
☐ ALL VOC ANALYTES BELOW FEDERAL MAXIMUM CONTAMINANT LEVEL (MCL)
🟪 ONE OR MORE VOC ANALYTES DETECTED ABOVE FEDERAL MCL

MW34-6D	MONITORING WELL ID
0.36 J	CARBON TETRACHLORIDE CONCENTRATION (μg/L); MCL = 5 μg/L
<1.0	1,1-DICHLOROETHENE CONCENTRATION (μg/L); MCL = 7 μg/L
<1.0	TETRACHLOROETHENE CONCENTRATION (μg/L); MCL = 5 μg/L
0.29 J,B	TRICHLOROETHENE CONCENTRATION (μg/L); MCL = 5 μg/L
<1.0	1,1,2-TRICHLOROETHANE CONCENTRATION (μg/L); MCL = 5 μg/L

NOTE:

DUPLICATE SAMPLES WERE COLLECTED FROM MW34-6D. THE CONCENTRATIONS PRESENTED ARE THE HIGHER OF THE TWO RESULTS.



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BALTIMORE DISTRICT

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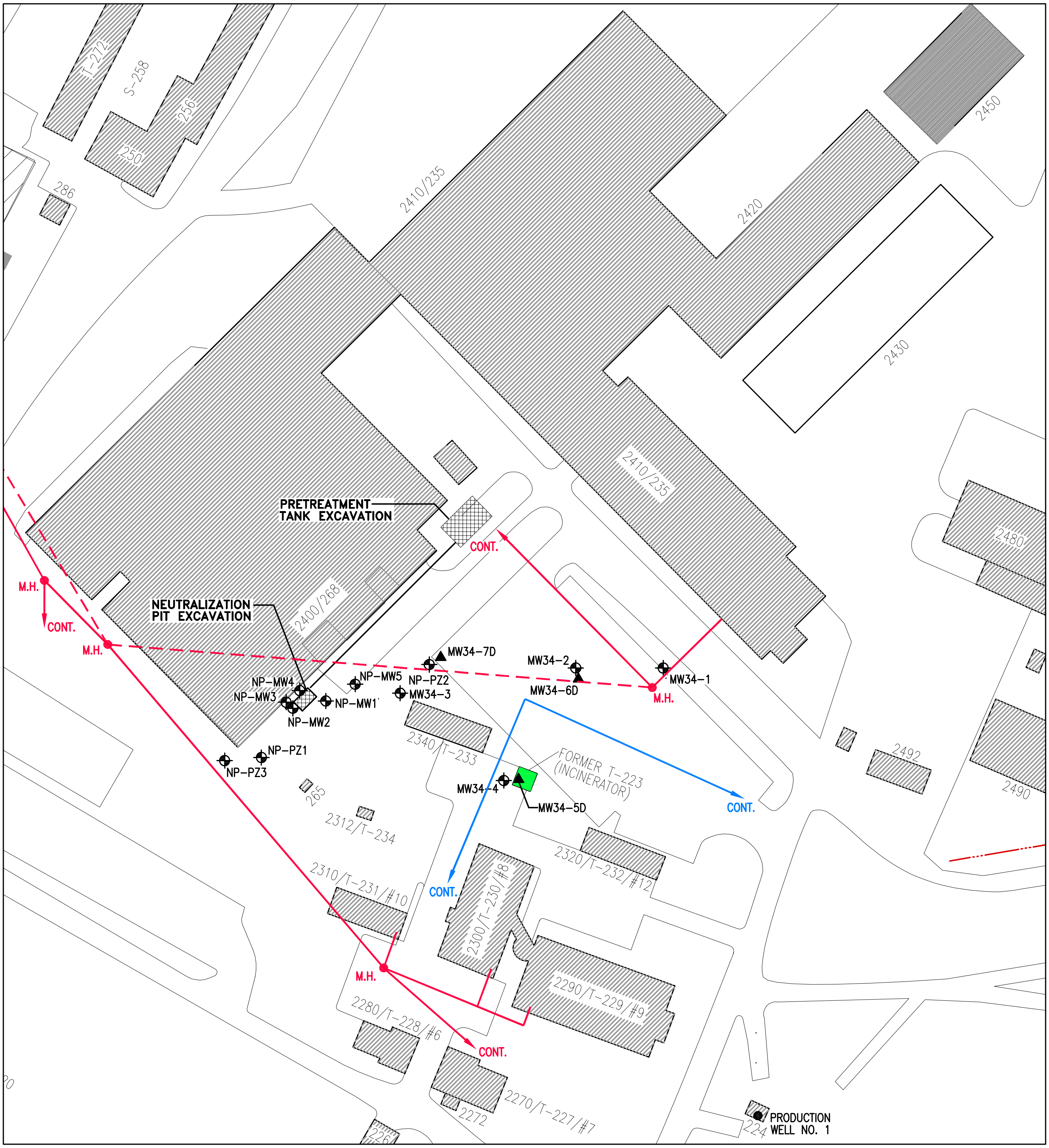
PREPARED WSS
CHECKED NZ
DATE 10-21-03
TASK NO: 84507908000000
SHAW DWG NO: GSA1-080-02-009

FIGURE 1-9
VINT HILL FARMS STATION

AREE 34
SRI BEDROCK
GROUNDWATER
ANALYTICAL RESULTS
(JANUARY 13, 2003)



LEGEND:

▨ .... BUILDING

MW34-4 .... OVERBURDEN MONITORING WELL

MW34-7D .... BEDROCK MONITORING WELL

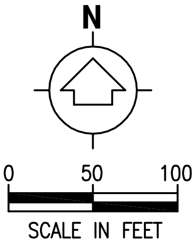
PRODUCTION WELL NO. 1 .... PRODUCTION WELL

M.H. .... MANHOLE

.... WATERLINE (APPROX. LOCATION)

.... SEWERLINE (APPROX. LOCATION)

.... ABANDONED SEWERLINE (APPROX. LOCATION)



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BALTIMORE DISTRICT

CONTRACT NO. DACA31-01-F-0142

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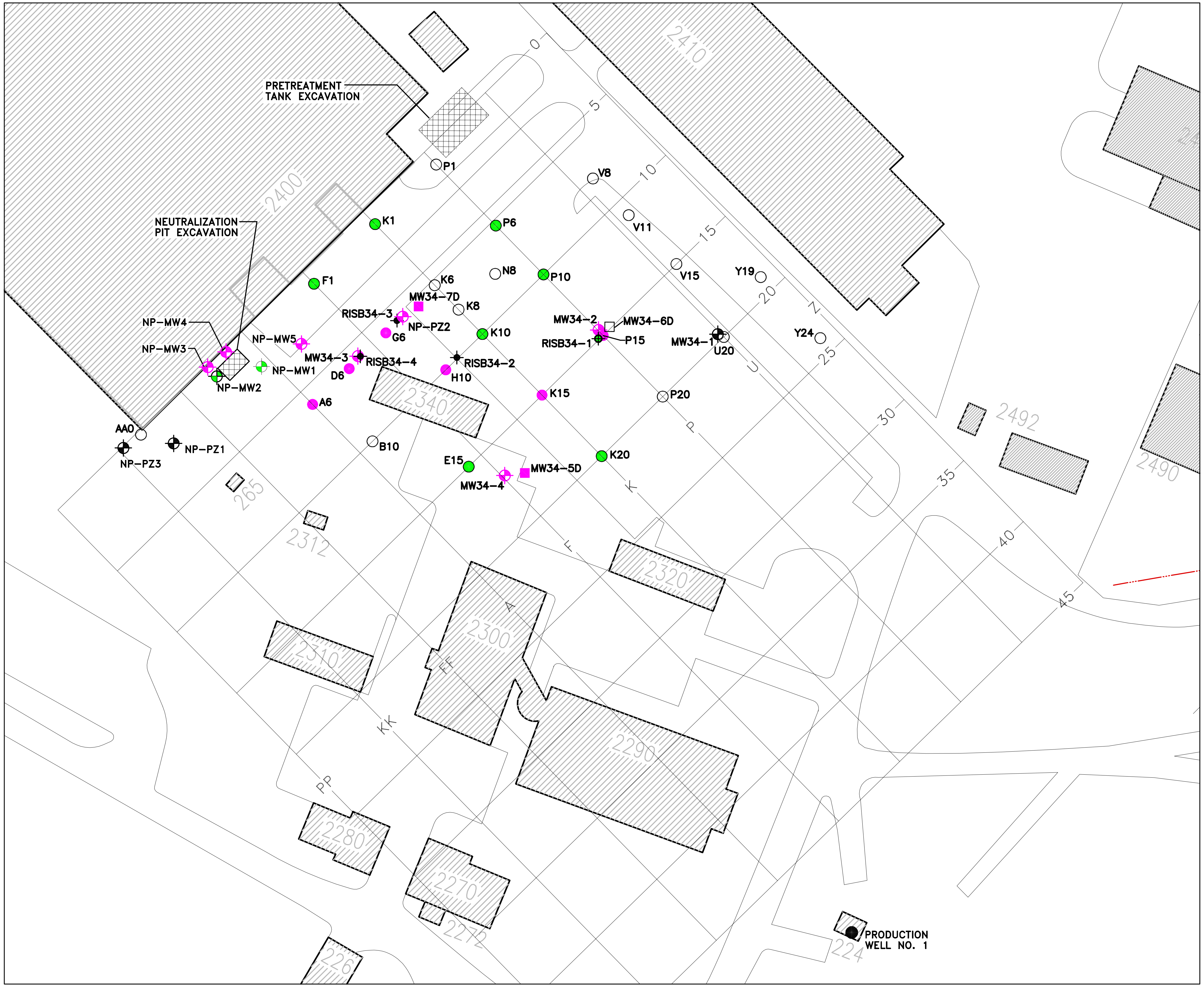
PREPARED	WSS	TASK NO:	84507908000000
CHECKED	NZ	SHAW DWG NO:	
DATE	10-1-03		GSA1-080-02-011

FIGURE 1-10

VINT HILL FARMS STATION

AREE 34 –
SURROUNDING
BUILDING AND
SITE FEATURES



LEGEND:

▨		BUILDING
○	U20	TEMPORARY MONITORING WELL (NO VOCs DETECTED)
🟢	K10	TEMPORARY MONITORING WELL (VOCs DETECTED BELOW MCL)
🟣	H10	TEMPORARY MONITORING WELL (VOCs DETECTED ABOVE MCL)
⊕	MW34-1	OVERBURDEN MONITORING WELL (NO VOCs DETECTED)
⊕	NP-MW1	OVERBURDEN MONITORING WELL (VOCs DETECTED BELOW MCL)
⊕	MW34-4	OVERBURDEN MONITORING WELL (VOCs DETECTED ABOVE MCL)
□	MW34-6D	BEDROCK MONITORING WELL (VOCs DETECTED BELOW MCL)
■	MW34-7D	BEDROCK MONITORING WELL (VOCs DETECTED ABOVE MCL)
✛	RISB34-2	HOLLOW-STEM AUGER SOIL SAMPLE LOCATION (NO VOCs DETECTED)
✛	RISB34-1	HOLLOW-STEM AUGER SOIL SAMPLE LOCATION (ONE TRACE VOC DETECTION)

0 25 50
SCALE IN FEET

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FIGURE 3-1
VINT HILL FARMS STATION

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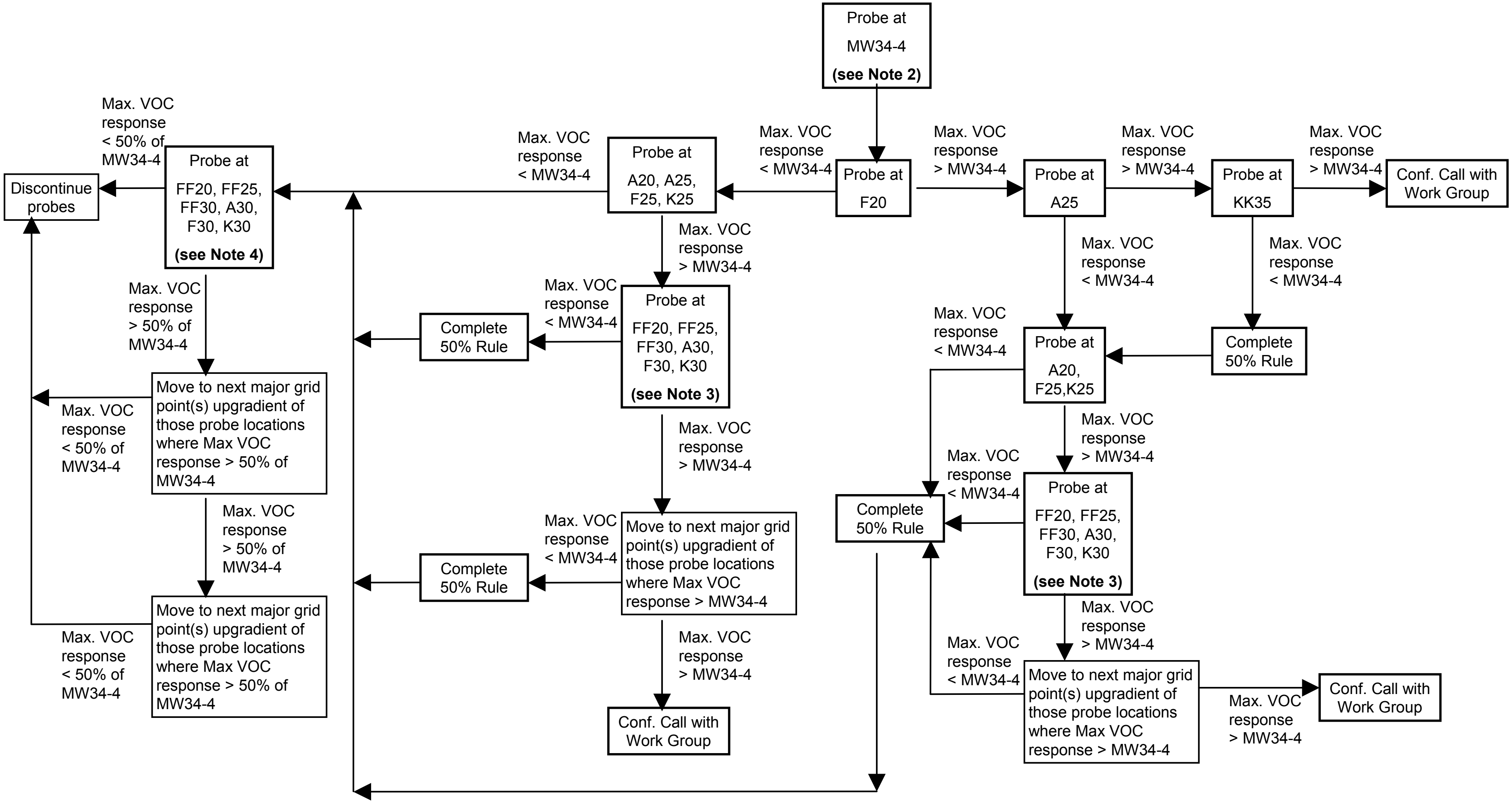
CHECKED	NZ	SHAW DWG NO:	
DATE	9-17-03		GSA1-080-02-010

AREE 34
FDVCO HIGH DENSITY
SAMPLING GRID

FIGURE 3-2

SAMPLE/PROBE LOCATION DECISION GUIDE (see Note 1)



Notes:

1 – This Decision Guide presents the rationale that will be used to determine subsequent sample/probe locations. Other criteria that will be considered in determining subsequent sample/probe locations are discussed in Section 3.1.4.

2 – If the MIP, with or without the sorbent traps, is not capable of collecting the data required to meet the objectives of the FDVCO investigation, soil and/or temporary monitoring well groundwater samples may alternatively be used. In the event this situation occurs, the selection of sampling locations will follow the approach presented in this Decision Guide.

3 – Probe only at the major grid points that are upgradient of grid points where the maximum VOC response exceeded the MW34-4 maximum VOC response.

4 – Probe only at those grid locations that have not already been probed (making reference to Note 3).

When there is a physical obstruction (i.e., a building) of a grid point to be sampled, the next closest grid point that has no physical obstruction will be sampled.

50% RULE: Between two grid points where the more downgradient of the two points has a maximum VOC response greater than or equal to the maximum VOC response at MW34-4 and the more upgradient of the two points has a maximum VOC response less than the maximum VOC response at MW34-4, select a grid point that represents approximately 50% of the distance between the two grid points for the next sample/probe location. Continue this methodology until the location of the highest VOC response is identified.